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SUPERFICIAL ESTIMATES OF POWER COST.

The tendency of electric power producers to overlook fixed charges in studying comparative costs is one of the oldest evils in the industry. It is amazing to find reputable engineers testifying in court and before public service commissions in a superficial manner upon important matters of this kind. In the recent instance of an electric railway petition for increased rates, a prominent professor of civil engineering with recognized expert standing in his own specialty attacked the company before the public service commission because it purchases power from a local central station at a total cost of 1.75 cents per kilowatt-hour and contended that by expending about $270,000 in the rehabilitation of several semi-obsolete scattered steam plants shut down by the use of central-station service, the railway might save about $40,000 per year. It developed under cross examination that the witness had not visited the plants in question, had no detailed knowledge of electrical design, and had made absolutely no investigation whatever of the changes in the distribution system which a proper handling of the loads would entail in case the plants were reconstructed, either in separated or centralized form.

About 10,000,000 kilowatt-hours per year were used by the company, whose officials testified that the shutting down of the old plants in favor of central-station energy had put the service on a new footing, improving the voltage conditions all over the system and enabling the company to operate a more flexible schedule than in the former days of local generation. Not the least advantage was the superior lighting of the cars obtained on remote portions of the lines, as compared with the previous situation.

The witness in this case dug his own grave, for the commission was thoroughly alive to the vital influence of fixed charges on total cost. It was shown that the company's old plants produced energy at a bare operating expense of 1.35 cents per kilowatt-hour, and the witness attempted to argue the futility of the central-station contract on the ground that many other plants in the neighborhood generate electricity at an operating cost of about one cent per kilowatt-hour. Vigorous questioning brought out the fact that if a new plant should be built by the railway company it could not be on tide water, and it was also shown that as the amount of power used increased, the railway gets the benefit of a sliding scale and a consequent lower unit price. Compar-

isons of its power cost per car-mile were favorable in relation to other roads in the state, the company spending about 4.47 cents, which was less than eight others in a list of eighteen.

The witness admitted that if fixed charges were taken into account there would be very little margin between the price now paid and the resulting local total cost. The municipality which retained the engineer thus obtained little value for its money, and all because of the superficial manner in which the problem was investigated. It was nothing less than absurd to go before a state commission with so little preparation of the engineering details of the case, and the thorough discrediting which the witness suffered should serve as a warning to other technical men who are tempted sometimes in the press of business to present "expert" opinions on questions a little out of their line needing thorough investigation. Off-hand and haphazard estimates of the wisdom of power contracts are rather uncertain proceedings in which to engage in these days of thorough study of such contracts by those who are called upon to execute them.

CHECKING OVERHEAD CHARGES PERIODICALLY.

At recent meetings of electrical contractors the importance of including adequate overhead charges in figuring bids has received due attention. It is now generally acknowledged that these real but often neglected costs cannot be overlooked with safety by the contractor, and one who does so is sure sooner or later to be overtaken by the inevitable factors of depreciation, insurance, superintendence cost, rental, etc. It is a question, however, if the importance of re-figuring overhead from time to time is sufficiently appreciated. Some contractors advocate doing this twice a year, others doubtless think that a yearly estimate is adequate. As a matter of fact, overhead expense should be re-figured whenever there is any reason to think that it has changed.

The enlargement of one's offices, the installation of new tools, motors or trucks, changes in insurance policies, salaries, and other items of this character should soon be followed by an intelligent effort to prorate them to the work in prospect. If things run along about the same from month to month, it is probable that a semi-annual estimate of overhead percentage will meet the requirements; but with large fluctuations in the volume of business, and even with seasonal changes in the conditions of work, electrical contractors are likely to benefit by computing their overhead figures three or four times a year, or even monthly. Many contractors are already figuring as to whether overhead charges should be based upon gross value of business, upon labor cost alone or upon other elements or combinations of elements entering into the business. This is a profitable subject to consider, and more will be heard from the trade along this line in the near future.

THE EIGHTH ANNUAL CONVENTION OF THE ILLUMINATING ENGINEERING SOCIETY.

On other pages of this issue will be found a report of the eighth annual convention of the Illuminating Engineering Society, which was held last week in Cleveland, O. The registered attendance was very close to 300, and while this is not as high as has been recorded in some previous years, it is very good considering the conditions under which this year's convention was held. The actual attendance at the sessions was high. The number of papers was large, as there were 27 papers and two reports presented at the various sessions in addition to the presidential address, while another paper was presented by title only. This large quantity of material necessitated the holding of parallel sessions both morning and afternoon on Wednesday, an arrangement which seemed to work out very well, although there were a few of the members who would have liked to attend both laboratory and commercial sessions. The large amount of material presented, coupled with the usual failure, except in the case of a few papers, of advance copies in time for previous study, perhaps crowded the program a little too much, and had it not been for the determined adherence of President Bond to the schedule, some of the sessions must have become wearisome. The general quality of the papers, however, and of the discussion which was presented, was very good.

The entertainment features of the convention proved delightful in spite of the fact that the weather man jumped his contract. With the temperature above 90 on the first two days of the convention, some inconvenience was naturally experienced, and greater satisfaction would have been felt if this weather had been vouchsafed upon the occasion of the outing to Nela Park on Thursday afternoon. The perfection of the arrangements, however, made up for any deficiencies in the weather and all present enjoyed the entertainment features thoroughly. The annual banquet, preparations for which were made by Mr. Luckiesh, presented the features which have become characteristic of this event and sparkled with merriment from start to finish. Serious remarks under these conditions seem to become more difficult each year.

ARTIFICIAL DAYLIGHT.

The consideration of the production of artificial daylight which shall correspond to daylight in spectral distribution came in for unusual consideration, as several of the papers presented touched upon this subject. Two of them were devoted to the production and examination of colored glasses which might be used with the ordinary illuminants, a Welsbach mantle and a tungsten-filament lamp respectively, to give daylight effects. While there may be doubts in some minds as to the general usefulness of glassware for this purpose, there are undoubtedly applications where it will prove exceedingly useful. A demonstration which was made at Camp Nela of its

convenience in and suitability for portrait photography interested many of those present.

In much color work it is necessary to compare or match colored objects under conditions which shall give results similar to those obtained in daylight, as that term is usually accepted. Unfortunately we have at the present time no exact and generally accepted standard of daylight. Although many industrial establishments use northern skylight for this purpose, it is known to vary from time to time; and this is true also of direct sunlight; neither, however, is always available even if it were constant. The suggestion of using black-body radiation from a body at a definite temperature consequently offers greater stability. This is convenient, however, only for comparison purposes and if a more portable standard can be determined by reference to it, it should have wide usefulness. This appears to be true of the equipment now available for this purpose.

For many purposes of artificial illumination, daylight is not required nor is it indeed wanted. For social purposes a yellower light appears to be preferred not only because of our being habituated to it, but because the excess of radiation in the red end of the spectrum brings out desirable tones. As for actual seeing, the maximum sensibility of the eye occurs in the yellow portion of the spectrum.

If the nearest approach to daylight is desired and at the greatest efficiency, we may look for an improvement when the gas-filled lamp utilizing mercury vapor in place of nitrogen appears upon the market, since Dr. Mackay's paper indicated that this will be a nearer approach to white light than any of our present illuminants, and consequently can be corrected with the least loss in efficiency. According to Messrs. Luckiesh and Cady, an efficiency can be obtained with approximate simulation of daylight by utilizing 19 per cent of the light from the nitrogen-filled lamp. This would correspond to a specific consumption of about 2.5 watts per candle. For similar conditions, Dr. Mackay gives 1.75 watts per horizontal candle and states that this could be reduced to one watt per candle by using mercury vapor in the bulb. The figure given by Dr. Mees in connection with his color screen is 18 per cent for the total transmission of light from a tungsten lamp operating at 1.25 watts per candle in order to give a sensation of daylight, but it is not clear what particular quality of daylight is here concerned. Luckiesh and Cady give 18 per cent for a match with sunlight, using this lamp, but only nine per cent for a match with skylight. Mr. Brady does not give the transmission efficiency of his glass.

The efficiency which may be attained, depends very largely, of course, upon the accuracy with which the correction is made, since the artificial sources fall off rapidly in intensity as the violet end of the spectrum is approached. By disregarding exact quantitative consideration of the violet rays, a great saving in efficiency may be made.

FURTHER EXPERIMENTS ON EYE FATIGUE UNDER DIFFERENT CONDITIONS.

Another contribution to the study of the efficiency of the eye under different conditions of lighting was presented to the convention by Prof. C. E. Ferree, who has continued the work reported a year ago, with the co-operation of Dr. G. Rand. The question was raised last year as to whether the surface brightness of objects in the field of vision was the most important element in determining loss of efficiency of the eye as defined by Dr. Ferree. It will be recalled that the efficiency of the eye is measured in these tests by its ability to see a specified test object clearly over an interval of three minutes, the quantitative value being computed as the ratio of the time during which the object is seen clearly to the time during which it appears blurred.

In the tests reported this year the position of the observer was altered in order to vary the number of bright surfaces in the field of view with a given lighting installation. Measurements of surface brightness were made and it was, of course, found that the greatest contrasts in the value of this element occurred with the installation of direct lighting used, whereas the contrast is least with the indirect lighting. With the semi-indirect installation, however, where the order of contrast approaches more nearly indirect conditions, the loss of efficiency approaches more nearly the values found with the direct installation.

The fact noted in the tests that the greatest loss of efficiency is found with the direct installation used, confirms the general belief that glaring sources in the field of vision not only interfere with seeing but are actually deleterious, since the direct installation used consisted of bare tungsten-filament lamps. It should be noted, however, that even when the position of the observer was so chosen that none of these lamps were directly in the field of view, a loss of efficiency resulted which was far greater than that observed with the indirect lighting installation, although much less than for any other position. Something more is evidently involved than mere contrasts in surface brightness as measured by their ratio, but the absolute values of the surface brightness may be in themselves a very important element.

The popular impression that motion pictures fatigue the eye was demonstrated by actual tests. Interesting results were also obtained with the use of eye shades, and it was concluded that the eye obtains less relief from the use of a shade with a dark surface than from one with a light-colored surface.

The trial of Dr. Ferree's method by other observers, especially Mr. J. R. Cravath, added confidence to the suitability of the method for the purpose involved, since it shows that general results of the same nature can be obtained by other observers using the method. It is to be hoped that further experiments will be carried out under a greater variety of conditions and with installations which are more typical of the respective systems of lighting represented.

Business Publications Hold Annual Convention in Chicago.

The Ninth Annual Convention of the Federation of Trade Press Associations was held at the Congress Hotel, Chicago, Ill., Thursday, Friday and Saturday, September 24, 25 and 26. In the electrical field the *Electrical World*, of New York, and the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, of Chicago, and in its closely allied field, the *Electric Railway Journal*, New York; *Electric Traction* and *Railway Electrical Engineer*, Chicago, are members of the Federation. This Association is comprised of the leading business publications of the country. It is devoted to the development of progressive ideas in publishing, so that there may be maximum efficiency upon the part of trade publications, and the slogan of the Federation is "Business Building Through the Business Press." A notable program was arranged and three full days were devoted to the various sessions. The chairman of the Committee of Arrangements was E. R. Shaw, publisher of the *Practical Engineer*, Chicago. From the opening address, which was delivered by A. A. Gray, president of the Chicago Trade Press Association and general manager of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, to the formal closure by Harry H. Wheeler, vice-president of the Union Trust Company, Chicago, and first president of the Chamber of Commerce of the United States, the dominant idea expressed in every session was along lines of benefiting the public at large through the education of the masters of industry so as to produce greater efficiency in business building and an acceleration in the development of industrial management. A notable address was delivered on Thursday morning by Professor John D. Shoop, assistant superintendent of the Board of Education of Chicago, entitled "Educational Opportunities and Obligations of the Business Press." Addresses were also made by David Beecroft, technical editor of the Class Journal Publishing Company, of New York, on "Feature Articles in Different Fields of Trade Journalism;" by F. M. Feiker, editor of *Factory*, Chicago, on "Merchandising of Ideas;" by S. T. Henry, of the McGraw Publishing Company, New York, on "Inter-Departmental Co-operation in Circulation Building;" by Andrew N. Fox, advertising manager of the Benjamin Electric Manufacturing Company, Chicago, on "The Educational Value of Advertising;" by Charles L. Benjamin, advertising manager of the Cutler-Hammer Manufacturing Company, Milwaukee, on "Business Building Through the Business Press;" by John N. Willys, president of the Willys Overland Company, Toledo, on "Influence of Trade Press in Building Up the Motor Car Industry;" and by L. F. Hamilton, advertising manager of the National Tube Company, Pittsburgh, on "Stimulating Subscribers to Read the Business Press Thoroughly and Systematically." There were many other papers of equal importance which would not, however, be of particular interest to the readers of this publication.

At the banquet on Friday evening addresses were made by John J. Arnold, vice-president and manager, First National Bank of Chicago, on the "New Commercial and Industrial Era," and by Professor John A. Scott, of Northwestern University, Evanston, Ill., on "Business and Its Literature." Douglas Malloch, managing editor of the *American Lumberman*, Chicago, delighted those in attendance with a fine flow of wit and humor.

At the close of the business session on Saturday morning officers for the ensuing year were elected as follows: President, John Cylde Oswald, of the *American Printer*, New York; vice-president, A. A. Gray, ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, Chicago; secretary-treasurer, Grant Wright, *Eastern Dealer in Implements and Vehicles*, Philadelphia, Pa.

Boston Motor-Car Club.

The Electric Motor Car Club of Boston resumed its regular meetings with a luncheon at the City Club September 23. E. S. Mansfield, vice-president, was chairman of the meeting which followed. Announcement was made of the plans for the convention of the Electric Vehicle Association of America, to be held in Philadelphia October 19, 20 and 21. Several of the Boston members will attend.

The secretary, C. H. Miles, reported preliminary arrangements for the Electric Vehicle Salon, to be held at the Copley-Plaza Hotel, Boston, November 2 to 6. The affair will be conducted mainly on the lines of the salon of last Fall, but manufacturers of charging apparatus, as well as passenger-car manufacturers and agents, and storage battery manufacturers will be among the exhibitors. All the members of the Boston Club will enlist their hearty support of the salon.

A Nominating Committee to nominate the officers for the coming year was chosen, consisting of H. F. Thomson, Morton J. Fitch, Philip E. Whiting, John Buckley and J. W. Emery. The annual meeting will be held October 14th.

Chicago Electric Club.

"China and Its Possibilities" was the subject of an illustrated address before the Electric Club of Chicago, delivered by Marcus Stowe Hill, of the Chicago Association of Commerce, on September 24. Mr. Hill called attention to the imports to China which have been cut off and which can well be supplied by this country.

Electrical Mardi-Gras in Philadelphia.

On Saturday, September 19, an electrical sales force Mardi-Gras was held by the various electrical interests of Philadelphia at the athletic field of the Philadelphia Electric Company, just outside of that city.

The festivities opened with a baseball game between the feminine employees of the Western Electric Company and the Philadelphia Electric Company. This was followed by athletic events of various kinds for men, women and children. The official starter for the events was Percy C. Rosenberg and the referee, James B. Juvenal.

Over 2,000 persons were in attendance, representing the central-station company, the City Electrical Bureau, the Jovians, the fire underwriters, manufacturers, electrical contractors and electric-vehicle interests. Refreshments were sold through the means of coupons, which were procured six for a quarter, including a chance upon an electric chafing dish. After supper, prizes were awarded by Gilbert S. Smith, of the electrical contracting firm of J. F. Buchanan & Company. Many beautiful and expensive prizes were awarded.

The following were the chairman of the various committees: General, W. B. Ahern; Grounds, E. J. Walsh; Sports, R. L. Lloyd; Refreshments, F. W. Clark; Prizes, Gilbert S. Smith; Publicity, J. E. Dougherty; Music, W. T. Dyre; Costumes, Paul Thatcher; Decorations, W. W. Cloud; Finance, Edwin Hulley; Tickets, George Lovett; Transportation, W. A. Manwaring.

Wireless Station Closed.

By direction of President Wilson, the radiograph station of the Marconi Company at Siasconset, Mass., was closed to business last week. The reason for this action was the company's declination to recognize the right of the government to censor messages. The company had just previously filed suit for an injunction in a Federal District Court of New York, to restrain the naval officers from closing or censoring messages at the station.

The government's final action was based on the Attorney-General's opinion that the president, as Commander-in-Chief of the army and navy, has the power to enforce measures to preserve the neutrality of this country.

It is suggested that the government may take charge of the station and handle messages on account of the Marconi Company. The local manager and one operator will remain at Siasconset, two operators being transferred to the company's station at South Wellfleet, on Cape Cod.

T. F. Grover.

To have grown up with and seen the evolution of the central-station and electric-railway industries is an enviable experience that relatively few of us have enjoyed. This is something that can be boasted by T. F. Grover, the new president-elect of the Indiana Electric Light Association. For nearly 30 years he has been engaged in the electrical business, serving from fireman up through a range of construction, operating, engineering and executive positions with various utility companies.

T. F. Grover was born in Blairstown, N. J., in 1865. In that city he received his public-school education and later took up the machinist's trade. In 1885 he came to New York City and served an electrical-engineering apprenticeship with the old Edison United Manufacturing Company. Three years he remained with this pioneer organization. On leaving the company he was engaged in the installation of the electrical plant of the Metropolitan Museum of Art in New York City, which was regarded as a model at that time. When this installation was completed, Mr. Grover became its engineer in charge. This plant was one of the largest isolated plants at the time and was also one of the first ones in which storage batteries were employed on a large scale successfully.

Mr. Grover came to the West in 1892 and for some time was engaged in the installation of lighting plants in various localities. Early in 1893 he became superintendent of the Milwaukee & Wauwatosa Electric Company, retaining this position until the company was absorbed by the Milwaukee Electric Railway & Light Company in 1896. He then went to Fond du Lac, Wis., and became vice-president and superintendent of the Fond du Lac Electric Company. This company operated electric light and power, gas and street-railway plants, the construction and operation of which Mr. Grover directed. In 1902 the Fond du Lac & Oshkosh Electric Railway Company was organized and built an interurban railway between the two cities, a distance of about 19 miles. Mr. Grover became the manager and later the president of this company. When the Eastern Wisconsin Railway & Light Company was organized in Fond du Lac in October, 1903, he became its vice-president and manager.

In 1907 the property of the Terre Haute Traction & Light Company, Terre Haute, Ind., was taken over by the Terre Haute, Indianapolis & Eastern Traction Company, and at this time Mr. Grover began his connection with the latter organization. His position is general manager of the Terre Haute Division of the company. He is also president of the Terre Haute & Western Electric Railway Company. As general manager he has general charge of the interurban lines radiating from Terre Haute to Brazil, Clinton, Sullivan and other points in Indiana, and to Paris, Ill. The operation of the local street-railway lines in Terre Haute is also under his charge, as well as the operation of the district steam-heating lines and the electric light and power system in the city. The lines of the company supply six substations in Brazil, Seelyville, Sullivan, Farmersburg and Atherton, Ind., and Vermilion, Ill. Energy for electric light and power is also furnished to Coatesville, Knightstown, Harmony, Mulberry, Staunton and Zionsville.

T. F. Grover,
President-Elect, Indiana Electric Light Association.

Mr. Grover has always been active in the associations of public-utility interests. While in Wisconsin he took a particularly active part in the old Northwestern Electrical Association (now the Wisconsin Electrical Association), which resulted in his election to the presidency thereof in 1904. In that year he was its official delegate to the International Electrical Congress in St. Louis. Mr. Grover is a member of the National Electric Light Association, the American Electric Railway Association and, as shown by his election last week, a very active member of the Indiana Electric Light Association.

Importance of Public Utility.

D. L. Gaskill, of Greenville, O., who is president of the Greenville Electric Light & Power Company, and is also secretary of the Ohio Electric Light Association and the National District Heating Association, was the principal speaker at a recent meeting of the Dayton Jovian League, his subject being "The Importance of the Public Utility." Mr. Gaskill made a strong plea for fairness on the part of the public toward public-service concerns, pointing out the necessity for co-operation between the people and the utility corporations in order to get the right kind of service.

Municipal ownership, which has proved to be a failure in most of the cases where it has been attempted, should not be thought of by a city which is able to secure adequate service, at fair rates, from a well managed private company, and that in Ohio, where the Public Utilities Commission with full jurisdiction sees that service is good and rates fair, there is no reason why any city should attempt to run its own electric plant. The example of Hamilton, O., whose municipal gas, electric and water plants all lost money last year, was cited to show what may be expected of municipal ownership.

Chicago Jovian League.

At the meeting of the Chicago Jovian League on September 28, J. H. Mallon, assistant superintendent of transportation, Chicago Elevated Railways Company, delivered a very interesting illustrated address on "Safety First." Mr. Mallon confined his remarks to the educational work among employees and public co-incident with the through routing of trains on the elevated lines last spring. Dr. H. E. Fisher demonstrated measures for giving first aid to injured.

A rejuvenation will be held in Chicago on October 5.

English Electric Works and the War.

The classified list of British electrical engineers who are willing to help either in the Army or Navy services, or in the maintenance of public electric systems, during the war, bids fair to be of considerable assistance if hostilities are long continued. The call to arms has been responded to by quite a large number of men engaged in power-station and distribution work, far more than it seems likely will be obtainable to fill their places through the ordinary channels. The shortage will be aggravated as recruiting gathers force. While in some works by co-operation and redistribution of duties men remaining behind will do their defenders' work as well as their own, it cannot be expected that this sort of thing can be carried far or for any length of time without impairing the efficiency of electrical service given. Urgent advertisements are appearing in the electrical press for electricians in charge, substation attendants and so forth, to fill the vacant places.

We shall see before long whether commercial development policies of electric supply systems will have to be deferred until employees' places are again fully manned, but according to reports from some directions the reduction in the total staff hardly suggests that there will be a surplus of staff or commercial enterprise available to push for new business yet awhile. It was the general experience during the South African war that expenditure on electrical work in the house could wait better than many other matters, and it was not until years after the war ceased that real revival in house installations set in again. Of course, the times are different and the appreciation of electrical service is totally different, though money is tight and will so continue.

One London company had up to September 2 lost 75 employees of all grades in the generating and distributing departments, who had gone on naval or military service.

Among the manufacturers may be mentioned the British Thomson-Houston Company, which has 400 men at the front (10 per cent of its male employees), and the General Electric Company, Limited, which has lost 75 men from its head London office, 70 from provincial branches and 165 from works.

In many towns and cities employees of electric supply and tramway undertakings, as well as workers in electrical manufactories, are subscribing a fixed proportion of their salaries to the Prince of Wales' Relief Fund, and in many cases places are being kept open for men "at the front" and their dependents are being allowed half wages during the period of absence.

In the early days after war was declared the electrical manufacturers' association issued an appeal against the suspending of contracts. But during the first four weeks such temporary suspension must have been quite made up by new business which went to English works, owing to contracts with Germany being cancelled by the war. It is said that these ran into five million dollars in value. Of course, on the other hand, there was naturally business held up or hindered owing to electrical firms being unable to get raw material and some other supplies which they were in the habit of procuring in Germany or Austria. The Bradford municipality ordered a 5,000-kilowatt turbogenerator set from Bergmann, of Berlin, early in the year and this was practically ready for dispatch when the war broke out. That plant will, of course, not now reach its intended destination, and the order for a set to take its place has been given to the British Westinghouse Electric Works at Trafford Park. Other engineering works of a much larger value for the Port of London authority, placed originally in Germany, are now being re-tendered for by English firms.

A very determined attack has been made in parliamentary and press circles in London upon the large number of electrical manufacturing concerns operating in England, which the official share registers show to be owned almost completely by German individuals or companies. The taking over of these works by the government for the period of the war was advocated.

New Turners Falls Plant.

Construction is going forward for the new 45,000-kilowatt hydroelectric generating plant of the Turners Falls Company, at Montague City, Mass. The development calls for the construction of a canal more than two miles in length, and a power station of brick and steel, 80 by 250 feet, and 106 feet high.

The excavation work is well under way, and the foundations and draft tubes, with the concrete scroll cases for the water wheels, have been poured in concrete, reinforced with steel rods.

The entire construction requires the moving of a million cubic yards of earth and rock, and the use of about 45,000 yards of concrete in retaining walls, headgates and foundations of the station.

The site of the new station is a mile below the town of Turners Falls, Mass., on the Connecticut River. Energy generated at the new plant will be distributed over the territory now served by the Amherst Power Company in the Connecticut Valley of Western Massachusetts. The transmission company's 66,000-volt high-tension line has an extent of about 50 miles, with another 50 miles of 13,200-volt line serving various outlying communities.

F. L. Hunt, chief engineer of the several generating and distributing companies united under the Cabot interests, has oversight of the work, the excavation being under contract to the Holbrook, Cabot & Rollins Company, of Boston, and the station construction to Fred T. Ley Company, Incorporated, Springfield, Mass.

It is expected that the plant will be in operation in about a year.

Meeting of National Council for Industrial Safety.

The third annual Safety Congress of the National Council for Industrial Safety will be held in Hotel La Salle, Chicago, Ill., on October 13-15. From five to six o'clock on October 13 motion pictures entitled "The Lineman" and "Safe and Unsafe Practices on Interurban Electric Railways," will be shown.

Although none of the papers that are to be presented deal entirely with electrical hazards, many will consider such hazards. M. W. Alexander, General Electric Company, West Lynn, Mass., and J. C. Parker, electrical and mechanical engineer, Rochester Railway & Light Company, Rochester, N. Y., will enter into the discussion of a paper on "Co-operation in Safety Work by Manufacturers and Trade Associations," by Fred C. Schwedtman, Springfield, Ill.

New York Electrical Society.

The New York Electrical Society will hold its opening meeting for the present season at the New York Electrical Show, Grand Central Palace, on Friday evening, October 9. A lecture on "Electricity in Warfare" will be presented by Capt. S. S. Robison, of the Bureau of Steam Engineering, Navy Department, Washington, D. C.

This meeting follows the precedent of many past years in which the New York Electrical Society has participated actively in the Electrical Exposition and has enjoyed its hospitality.

A Year's Work on the Lincoln Highway.

Out of 3,389 miles of the Lincoln Highway route between New York and San Francisco, over 2,500 are already marked with the tri-colored marker; work has been done in every one of the twelve states traversed; work is now going on in every one of these states. The route is now in such shape that it is possible to tour from the Atlantic to the Pacific in less than a month. It is expected that thousands of cars will use the Lincoln Highway in crossing the country next spring.

Electricity in Grain Elevators.

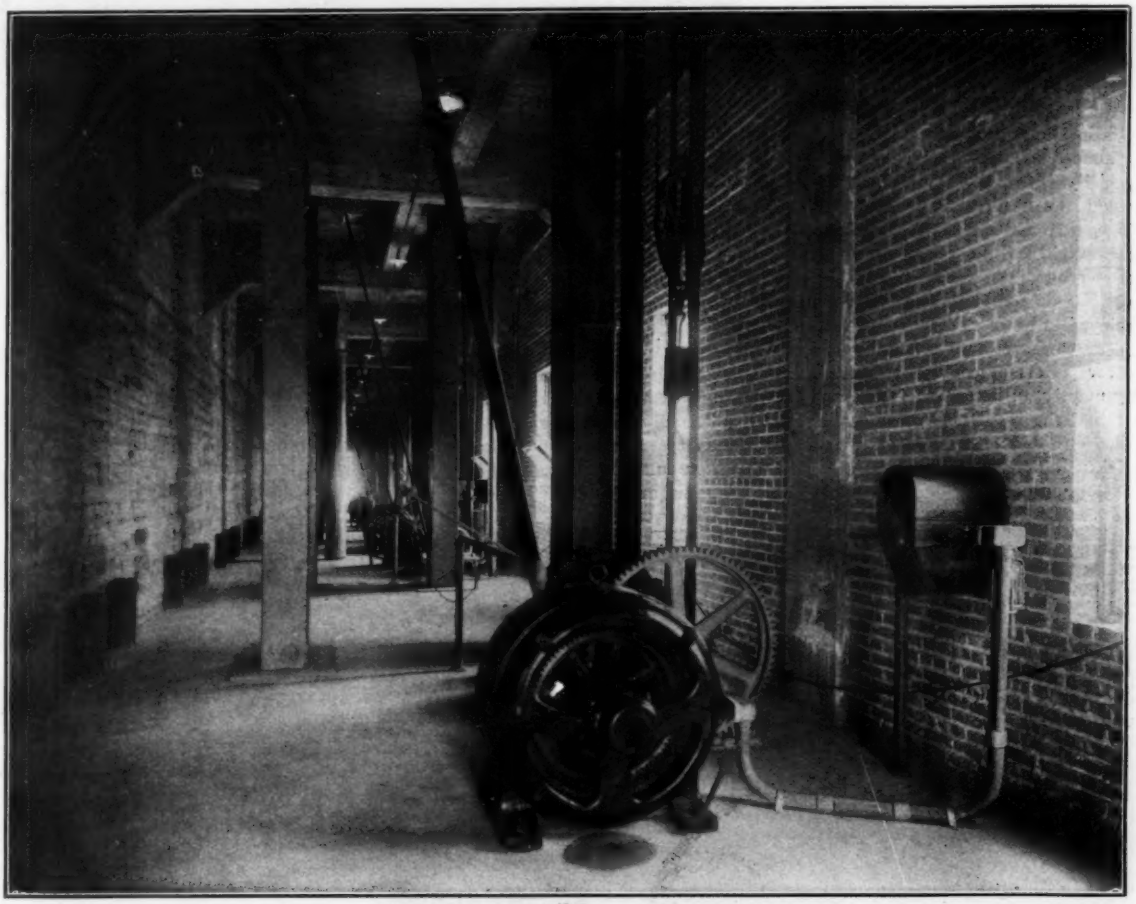
This article discusses the conditions found in the average small grain elevator, driven by gasoline engine and in the larger steam-driven plants, pointing out the advantages of electric drive with central-station service. Particulars are given on a new elevator which has recently adopted purchased power in Chicago.

In practically every city or town large enough to support a central-station company will be found a grain elevator or warehouse that offers a profitable field for central-station service. In the smaller localities gasoline engines have been widely used for this service because of the expense of maintaining a steam plant under the conditions obtaining in the usual small elevator. The operation in such establishments is intermittent with occasional calls for 24-hour service and the average load-factor is slightly above 10 per cent. However, actual tests and installations in innumerable instances have shown the electric motor to be infinitely more economical and reliable than the gasoline engine for elevator service and the number of electrically operated plants is rapidly increasing.

It is unnecessary to comment at any length on the disadvantages of the gasoline engine for this service as any operator has had unfortunate experiences that are common to almost all engines. Particularly in winter is trouble encountered and the experience of one central station in meeting competition of this kind may be of interest. The grain elevator in question was being operated by a 10-horsepower gasoline engine which was particularly hard to start in winter. The manager finally decided to purchase a kerosene heater which seemed to admirably eliminate previous difficulties. Upon investigation by the central-station salesman, however, it was found that the cost of the kerosene used would almost pay for the electric power necessary to operate a 7.5-horsepower motor, which was subsequently installed. A detailed comparison in operating costs showed an almost ridiculous saving in favor of central-station service when items such as attendant's time in starting engine, repairs, fuel, etc., were considered.

This particular case is somewhat unusual but serves to illustrate the degree of competition that is offered by the gasoline engine. When all items are considered it is safe to say that central-station service will reduce the cost of handling grain 20 to 30 per cent over gasoline-engine drive.

Practically the same conditions apply to the larger elevators employing steam engines, although the details are somewhat different. Where steam engines are used it is the practice to drive the legs and conveyors in grain elevators by means of long lines of shafting or by rope or belt transmission. The friction losses in such installations is, of course, directly proportional to the size of the plant and the number of machines driven and represents a large percentage of the total power required.



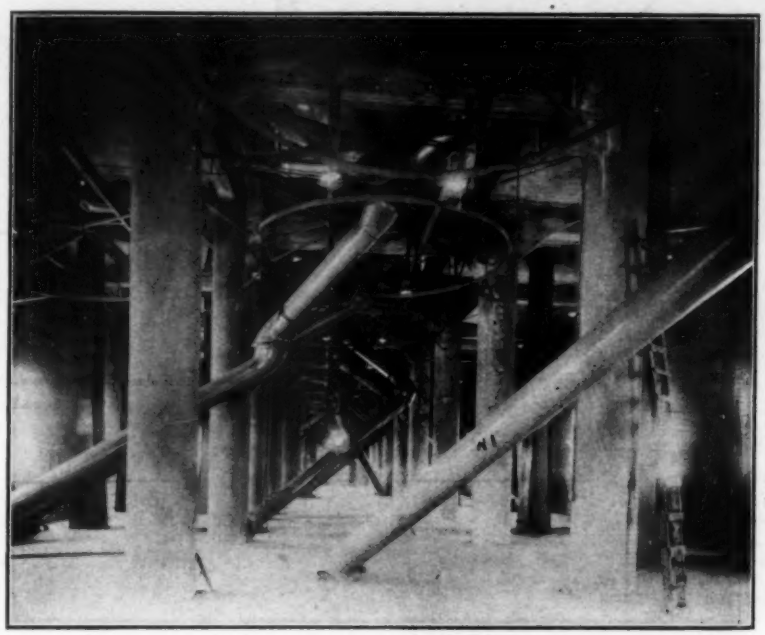
Motors Driving Elevator Legs. Back-Geared 50-Horsepower Motor in Foreground. Michigan Central Elevator, Chicago.

It is evident that by using an individual motor either direct-connected, belted or provided with a relatively short rope drive for each elevator leg, conveyor, car puller or exhaust fan, the inevitable loss of friction resulting from long lines of shafting, or from long rope or belt connections is to a large extent eliminated and the total horsepower reduced to a minimum.

Even where group drive is resorted to, and under the most unfavorable conditions, the friction loss with motor drive would be far less than that which results from driving the various units from a single source of power through long lines of shafting or other mechanical means of power transmission.

The use of an individual motor drive under the low load-factor conditions existing in grain-elevator service demands, if the installation is to be successful from a commercial standpoint, that motors of relatively small rated capacity be used, and that full advantage be taken of whatever inherent capacity for overloads the motors possess. The characteristics of the induction motor make this type of motor almost an ideal one for this service, especially where the load can be applied through the medium of friction clutches.

The extreme simplicity and relatively light weight of the polyphase induction motor render it unnecessary to provide special foundations for the sizes usually employed in grain elevators. In some instances where motors are used to operate car pullers or conveyors, space economy may be an important factor, and the fact that the induction motor can be installed on the floor, wall or ceiling should be taken into account when providing for the adoption of motor drive.



Distributing Spouts and Conveyors in Michigan Central Elevator.

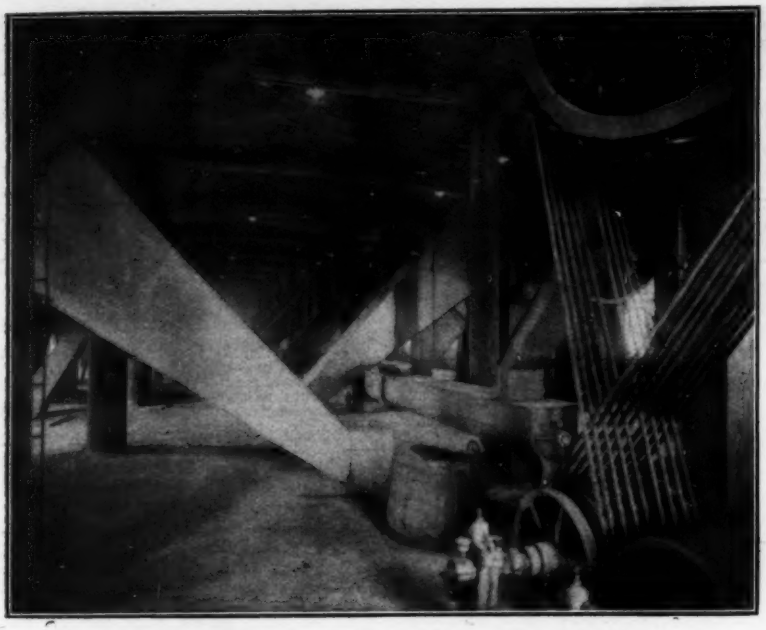
When the induction motor was first applied to elevator legs there was some objection raised because of the tendency of the leg to run backwards, due to the weight of the grain, when the power was shut off from the motor. This back-legging, or forming of a choke, is now rendered impossible by the use of an attachment which permits the motor to run only in one direction. The instant it is stopped a powerful friction clutch holds the leg stationary. In order that the elevator may start on full load, motors for driving this apparatus are generally provided with a friction clutch which is thrown in after the motor has attained full speed.

Individual drive in a grain elevator is theoretically the best method to realize on the many advantages of the electric motor, but in actual practice the usual method has been to combine the individual and group systems, using separate motors for elevator legs, conveyors, etc., and driving cleaning and separating machinery in groups. The extent of the individual and group drives depends upon conditions but it is advisable to divide the cleaning and auxiliary machinery into as small groups as possible, so as to eliminate friction losses.

This general scheme of drive has been followed in the new Michigan Central Transfer Elevator in Chicago which has recently been connected to the lines of the Commonwealth Edison Company. The installation here comprises 21 squirrel-cage induction motors, aggregating 557 horsepower. All of the important elevator legs are driven by individual motors while group drives, each comprising relatively few machines, are employed for other equipment.

Because of its being one of the largest, as well as one of the newest grain elevators in Chicago, using central-station service exclusively, a few remarks relative to the electrical installation may be of interest. The elevator was designed and built under the direction of Cecil Hodgson, who has contributed an interesting description of the plant to *Electric City*. In this article Mr. Hodgson comments interestingly on the question of power supply for grain elevators and his remarks are particularly significant because of his position as an expert on grain-elevator design. Speaking of motor drive in gen-

75-Horsepower Motor That Drives Cleaning Machinery.



Cross-Rope Drives in Michigan Central Elevator.

eral he says: "Electrical transmission introduces no objectionable features except a slightly greater initial cost. Placing this at 25 per cent greater than for the corresponding mechanical equipment means only about one and one-half per cent on the total investment. As a matter of fact this is probably saved in the cost of the building, as no special provision has to be made for transmitting the large amount of power required in the upper stories through the bin story, or for the large shafts necessary to transmit the power longitudinally both above and below the bins. No extra labor is required as it is not necessary to employ a skilled electrician for operation. On the other hand, subdivision of the power into small units, which may be operated as required, saves enormously in the cost of operation over a mechanical transmission, where long lengths of large shafting run continuously, for long intervals of time transmitting little or no load, and seldom being taxed to their full capacity. The writer estimates—and it is believed conservatively—that 85 per cent of the horsepower-hours developed at the engine shaft of the best, and hardest worked, mechanical-driven elevator are wasted. Such an elevator with electrical transmission would not need to generate or purchase more than 20 per cent of its present engine output.

"The small, and generally out-of-the-way, space required by the electrical equipment, compared to the large and valuable space required for mechanical transmission, is a great advantage in favor of the electrical transmission. Especially is this advantage appreciated where complex spouting arrangements below the bin story have to be adopted.

"A large number of grain elevator operating firms who have been, or are, operating elevators of both forms of transmission, questioned by the writer on this subject, unanimously declared themselves in favor of the electrical transmission for new elevators at no matter what expense and whether or not the power was generated on the premises or purchased from an outside source.

"Where electric service can be obtained, at the rates now prevailing in the large cities, a mechanically driven elevator, with a relatively low-cost power plant, can not compete on account of the inefficiency of this form of transmission. No refinements looking to greater economy in the power plant, but increasing the cost and consequently the fixed charges, will overcome this defect on account of the extreme variability of the load.

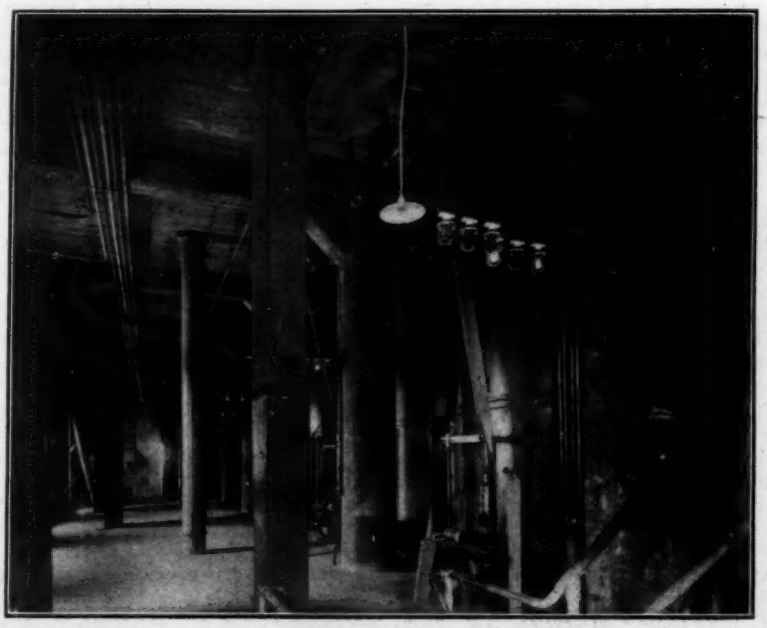
"An independent electric generating plant, due to the large size of the units it is necessary to install to meet the peak-load demands, involves a very large investment and consequently high fixed charges. The total output in kilowatt, or horsepower-hours per annum—that is, the load-factor—is very small. The necessity of keeping large units running, and in a steam plant a number of boilers under steam, to meet probable demands while the average load is very light, is not conducive to high, all-year, plant economy.

"The combination of high fixed charges and high operating costs generally make the cost of generating the power for a grain elevator prohibitive.

"The construction of a modern grain elevator involves a large investment and the possibility of eliminating additional investment for power generation is, where the appropriation or capital available is limited, a very attractive feature to the prospective builders.

"The difference of cost between generated power, together with the fixed charges on that part of the power plant devoted to, or chargeable pro-rata to, steam heating, as *e. g.* in the grain drier, and purchased power, will generally more than cover the fixed charges and the intermittent operating cost of a low-cost boiler plant suitable for heating purposes."

The Michigan Central elevator is located at One Hundred and Twenty-fourth



Scales and Electric Signal Lamps at Michigan Central Elevator.

Street and Cottage Grove Avenue, a junction point for several of the principal western and eastern railroads. The plant comprises the elevator proper, 150 feet long, 52 feet wide and 170 feet high, the drier house surmounted by three large cylindrical garners, boiler house, which is used exclusively for drying grain, and a bleacher tower, six feet square and 55 feet high.

The buildings have, of course, been laid out with respect to convenience in unloading and loading cars on the adjacent tracks.

The usual complement of elevator legs, spouts, conveyors, etc., are provided and, as is common to all elevators, full advantage is taken of gravity in loading grain into cars and bins.

Within the main building three receiving and two shipping elevator legs are lined up on one side, three receiving and two cleaner elevator legs on the other side, two drier elevator legs at one end and two bleacher elevator legs at the other end. The receiving and shipping elevator legs are each capable of elevating 10,000 bushels of grain per hour, the others 6,000. The receiving elevator legs have approximately 325 buckets, and elevate the grain 168 feet.

The cleaning and auxiliary machinery is located on the first floor. This equipment comprises two cleaning machines and two dust packers, the function of the former being to pass the grain through the suction draft produced by fans within the machine—which deliver the dust to cyclone dust collectors. This dust is packed in sacks and sold as cattle feed. Each cleaning machine has a capacity of 5,000 bushels per hour.

Three oat-lipping machines are also located on the first floor, these each having a capacity of 1,500 bushels per hour. The method of drive in this elevator is to back-gear the motor to a countershaft and drive by rope from sheaves on these shafts. In many cases a speed reduction of 16 to 1 has to be obtained. The oat clippers are driven direct from the motors by means of rope.

One of the interesting features of the electrical equipment at the Michigan Central elevator is the electrical operation of the grain scales. Eight scale tanks, 14 feet 6 inches in diameter and 19 feet high are located immediately below the garners. The capacity of each scale is 120,000 pounds. When weighing, a punched impression is automatically made on a ticket showing the weight of each load. An ingenious system of signal lamps, manually operated, forms the means of communication between the weigh master and the operators on the floors above and below.

The accompanying table shows the list of motors installed in the elevator, with their respective drives. The supply source is three-phase, 60 cycles, 440 volts, stepped down from 12,000 volts by means of three 200-kilovolt-ampere transformers.

MOTOR INSTALLATION.

No.	Horse-power	Speed R.P.M.	Application.
1	15	1160	Driving screw conveyor over garners.
6	50	480	Each back-geared and belted to a receiving elevator leg. Capacity of each, 10,000 bushels per hour.
2	50	480	Each back-geared and belted to a shipping elevator leg. Capacity of each, 10,000 bushels per hour.
2	25	575	Each back-geared and belted to a cleaner elevator leg.
1	50	575	Driving two drier elevator legs and screw conveyor over drier house.
1	35	575	Driving two bleacher elevator legs and screw conveyor over bins.
1	75	690	Driving drier fans.
3	75	690	Each connected by rope directly to an oat-clipping machine, capacity of each, 1500 bushels per hour.
1	75	860	Driving two grain-cleaning machines, one car puller, two power shovels, two dust packers and various lengths of screw conveyors.
1	7½	860	Driving bleacher blower.
1	5	860	Driving passenger elevator.
1	0.25	1750	Driving sump pump.

The matter of determining the amount of power required for driving grain elevators with induction motors, involves simple mathematical calculations, with the exception, of course, of determining the amount of power required to drive the various cleaning machines. These may be obtained with the assistance of data giving the necessary power requirements for machines used in up-to-date elevators.

The formula used in estimating power for driving belt conveyors carrying wheat is to allow 0.6 horsepower for each 100 feet of belt per thousand bushels of wheat. To this result should be added 15 per cent for friction losses. Addition should also be made for rise in belt, if any.

The formula used in estimating power for screw conveyors is to allow 1.5 horsepower per 100 feet of conveyance per 1,000 bushels conveyed per hour. To the result should be added 25 per cent for friction losses. The speed recommended for screw conveyors varies from 160 revolutions per minute to 225 revolutions per minute, according to the diameter and pitch.

It might be well to state here that the nominal capacity of a grain elevator as usually applied, gives no basis for figuring the amount of power required, for the reason that elevators are figured according to their storage capacity; for instance, either 50,000 bushels, 100,000 bushels, 200,000 bushels, 500,000 bushels, etc. The capacity as applied means simply the storage capacity, not the amount of grain which can be handled in a given period. In order to determine the amount of power required in a given elevator, the operation of the elevator must be carefully analyzed.

Boston Edison Company's Growth.

A preliminary report of the Edison Electric Illuminating Company of Boston shows that the number of customers has increased during the past year from 52,447 to 62,194. The total output of electricity for the year ended June 30, 1914, was 188,723,854 kilowatt-hours, as compared with 171,783,312 kilowatt-hours the year before. The distribution of energy was as follows:

	1914	1913
Kilowatt-hours delivered at switchboard for street lights	18,697,847	*17,739,443
Kilowatt-hours sold for street lights	14,257,184	*12,921,708
Kilowatt hours sold to commercial customers:		
For light and power, by meter	73,050,219	67,063,489
For power, except street railways	29,605,381	25,471,221
For street railways (A. C.)	9,542,968	8,318,756
To other companies.	4,197,917	4,247,904
Used by the Company for lights or auxiliaries	8,221,070	7,673,027

*Estimated.

Coal used during the year amounted to 179,364 long tons, compared with 167,097 tons the year before. The average cost was $3.92 the last year, and $3.796 the year before.

The number of motors on the system is 21,363, with a total rated capacity of 106,204 horsepower. There are 4,485 magnetite arc lamps on the systems.

The company has added nearly 3,000,000 feet of cables in underground conduits in the year.

The total cost of plant is given as $40,903,229. The amount of capital and loans is $26,754,900. The outstanding capital stock June 30 had a par value of $20,472,900. There are 4,803 stockholders, of whom 4,199 reside in Massachusetts.

Current sold to other lighting companies and municipalities, and the prices was as follows:

	Kilowatt-hours.	Average.	Amount.
Charlestown Gas & Electric Co.	2,033,126	.0149	$30.359.09
Cambridge Electric Light Co...	8,115	.0536	435.96
Union Electric Light Co.	666	.1790	119.66
Town of Wellsley	639.410	.0264	16,843.10
Town of Norwood	1,516,600	.0191	28,913.30

The company's principal sources of income were:

Commercial arc and incandescent lamps	$4,627,300
Public arc street lamps	529,003
Public incandescent street lamps	274.337
Power, except street railways	1,272,267
Power for street railways	165,707
Current sold other lighting companies	76,671
	$7,008,288

There was a loss of $29,030 in connection with the sale of appliances. Expenses were as follows:

Manufacture (fuel, wages at station, etc.)	$1,242,062
Distribution (care of lines, renewals, etc.)	845,178
Office expenses and management	776,475
Taxes	785,713
Insurance, law expenses, bad debts and incidentals	340,015
	$3,989,491
Balance to profit and loss	3,018,797

The ratio of operating expenses to gross earnings was 56.9 per cent, compared with 55.9 per cent the preceding year.

Commercial Practice
Management, Rates, New Business

A Commendable Central-Station Advertisement.

A recent advertisement of the City Light & Traction Company, of Sedalia, Mo., dealing with electricity as an advertising medium and business getter, contains many valuable suggestions and the text is reproduced herewith:

"The night has been called beautiful.

"It is beautiful, not of itself, but because of the natural and artificial intrusions of light. What are the heavens without the deep blue mantle of sky and a thousand stars? What is the inky night as compared with one which is silvered with the beams of the moon?

"Who has ever entered some great city ablaze with light and not had the pulses quickened?

"We have all stood entranced before some glowing majestic electric sign and admired its beauty. The eye gravitates toward light as the river to the seas.

"Every successful merchant, manufacturer and business man we credit with foresight; yet the overwhelming per cent of them are squandering a part of their capital.

"You have guessed what it is already. It is their piece of night.

"It cost them nothing, it will never be lost or taken away. Time or circumstances can not ever rob them. It is theirs!

"The merchant who pays high rent and leaves his shop windows empty would be a laughing stock in his town. The million-dollar department store with no window displays would rush into bankruptcy. Yet the great department store that does not flame out at night with glowing windows and dominating electric signs is robbing itself of its capital.

"I repeat it, it is throwing away something valuable, which costs nothing. To go further, it is lacking in business acumen, inasmuch as the darkness around it is really more valuable than the darkness ten miles away If this department store will not use it and make it pay, others will.

"And yet we have not gone far enough still. An electric sign and a well lighted window are salesmen. Some salesmen are better than others. There are salesmen who impress you as big, bright men. You know they are worth their high salaries. Some electric signs and windows are better salesmen than others. They dress better, talk stronger, and get better audiences.

"The conclusion is obvious. Make your sign and windows represent the standard of your business and they will sell the goods. They will work steadily sixty minutes in the hour; they never lose their enthusiasm; they will make friends and get business. Do not put a seedy-looking, run-down salesman on the road and expect him to get the business."

Returns from a Heating-Appliance Campaign.

The results of a recent campaign for the sale of heating devices conducted by a progressive central-station company are so convincing that a brief description will be of interest.

Daily demonstrations were given in the salesroom of the lighting company. Fifteen solicitors were employed for house-to-house canvassing; a delivery wagon carrying a supply of devices accompanied each crew of three solicitors covering a designated territory. Devices were sent out for a week's trial, to be paid for in installments if desired.

Liberal space was used in the local papers and the demonstrations were announced daily. Car cards were used; motion pictures of electricity in the home were shown in one of the theaters. Large banners and poster cards advertising the campaign were displayed at the theater. A show case of devices was also placed on exhibit at this theater. All patrons received a ticket entitling them to a chance for a percolator given away each noon. As a matter of co-operation, hand-bills advertising the motion-picture theater were given out at the sales demonstrations.

The advertised price of the iron was $2.75; that of the toaster, $2.50; and the two were offered at $4.99.

During 13 days of the campaign 1,185 people attended the demonstration, 381 making purchases; 2,205 sales were made in the house-to-house canvassing, making a total of 2,406 devices. Devices sold immediately after the close of the campaign brought the total up to 2,504.

The 2,504 devices represent 1,359 kilowatts added to the connected load. Basing calculations on the low average of two hours use per month for each device, the increase of revenue at a 10-cent rate will be $271.80. However, 1,304 of the devices were irons that in all probability will be used at least 20 hours per month. 1,304 irons represent 717 kilowatts and at a 10-cent rate for 20 hours per month gives a revenue of $1,434.00. The remaining devices representing a load of approximately 642 kilowatts, used two hours a month gives a revenue of $128.40. The total increase of revenue then was $1,434.00 plus $128.40, or $1,562.40.

An increase of such proportions is very attractive from the viewpoint of the central-station man who is endeavoring to build up his load.

No Deposits on Meter.

Public-service properties in five Oklahoma cities, owned by the H. M. Byllesby & Company, of Chicago, ceased requiring a deposit in advance for prepay gas meters, following a hearing by the Oklahoma Corporation Commission on a complaint against the charge, filed by C. L. Smith, of Oklahoma City.

At the hearing, Smith contended that the gas he used was paid for before being consumed and that therefore the company did not need protection against possible loss. The new rule will apply to gas and electric plants in Oklahoma City, Muskogee, Enid, El Reno and Sapulpa.

Rates in Sandusky.

The long-drawn fight between the City of Sandusky and the Sandusky (Ohio), Gas & Electric Company over the question of rates has finally been settled, both sides conceding something in order to reach an adjustment of the matter without a resort to litigation. The schedule as finally agreed upon provides for four and seven-cent rates for large and small consumers, respectively, instead of five and eight cents, as at present, with a reduction of the amount required in order to entitle the consumer to the lower rate. A minimum charge of 50 cents will be made, instead of 75 cents, as heretofore. The schedule will be incorporated in an ordinance which will be promptly passed.

Reduced Cost of Electricity.

It is of special interest to note the reduction in the average cost of electricity since 1900 to residents in the suburbs of St. Louis. While the cost of living has increased enormously the past 14 years, the cost of electric service has decreased wonderfully. The following table, compiled by the Union Electric Light & Power Company, shows the average consumption, average amount of the bills by years, and the average rate per kilowatt-hour from the year 1900 to date. In spite of the fact that these customers obtain 250 per cent more light for the same amount of electricity, they now use 2.5 times as much electricity as in 1900 at a lower cost. The average rate per kilowatt-hour has decreased from 18.12 to 7 cents.

	Average Number of Kilowatt-Hours per Year per Customer.	Average Bill per Year per Customer.	Average Rate in Cents per Kilowatt-Hour.
1900	376	$ 68.05	18.12
1901	408	72.23	17.72
1902	526	89.86	17.07
1903	570	93.74	16.45
1904	717	117.23	16.35
1905	587	73.95	12.51
1906	715	84.23	11.76
1907	746	84.11	11.26
1908	774	87.03	11.25
1909	876	97.87	11.17
1910	812	89.36	11.01
1911	702	76.58	10.9
1912	802	65.19	8.13
1913	875	65.25	7.46
1914 (Estimated)	900	63.00	7.00

Big Contract for Louisville Company.

Current from the waterside plant of the Louisville (Ky.) Gas & Electric Company is about to be supplied to the system of the United Gas & Electric Company, an Insull utility in Jeffersonville and New Albany, Ind. Workmen have completed stringing heavy cables across the Big Four bridge, which spans the Ohio River and connects Louisville and Jeffersonville, and the current, a maximum of about 1,000 kilowatts contemplated by the contract, will be transmitted to the Jeffersonville substation of the Indiana concern. This station is tied to the plant in New Albany, and the Louisville current will be floated upon the whole system. This current is needed to supply Jeffersonville at present, though it is understood that more will be taken later, the installation being sufficient to carry more than the 1,000 kilowatts.

Jeffersonville's requirements are indicated by 134 arc street lamps, some 1,000 horsepower of connected power load and the domestic and commercial demands.

Central-Station Power for Mines.

The West Penn Electric Company, of Pittsburgh, Pa., has closed a contract to furnish electric power to the Vesta Coal Company's No. 2 mine at Monessen, Pa., supplanting the old steam plant now used there. The equipment consists of one 150-kilowatt motor-generator set. This company is also equipping the Eclipse mine of the River Coal Company with approximately 600 horsepower and has recently finished the equipment of the Cresent coal mine, which is approximately 900 horsepower. The old steam plants have become antiquated and the coal companies have seen decided advantages in providing their plants with modern methods of operation. During the past nine months the West Penn company has taken on approximately 3,100 horsepower electrical load in the mining and manufacturing plants of the district.

Advantages of Electrically Driven Feed Mills.

The Electric Feed Mills, of Franklin, Ky., is turning its modern motive power and machinery equipment to good account in its advertising in the local papers, announcing to the farmers, that the electric motor obviates disadvantages of the steam mill. "Electric power," the advertisement reads, "hence no noise to frighten horses." At the same time the concern, with its compact, clean and noiseless machinery outfit, was enabled to locate almost on the public square and holds out this inducement to its farmer patrons: "A location near the square where you can get your grinding done and do your shopping at the same time."

Electric Power for Insane Asylum.

The Alton Gas & Electric Company has been awarded a ten-year contract by the Illinois State Board of Administration for furnishing electric power for the new state hospital for insane to be erected at Alton, Ill. The company is to furnish from 400 to 500 horsepower of electricity for light and power. The new hospital is to be electrically equipped throughout. A substation will be built at the hospital and from there the current furnished by the company will be distributed to the various buildings. The laundry will be electrical throughout, and corn-shredding machines, the churns, the farm machinery used about the barns and everything that is stationary in the way of machinery will be run by electric motors.

Kenyon Gets Wholesale Supply.

The Consumers Power Company has closed a contract with the local company in Kenyon, Minn., to furnish the latter with wholesale power. This will require the construction of a 10-mile extension from the line of the Faribault division. The distribution system of Madison Lake is already being supplied by the Consumers Power Company.

Economy of Central-Station Service for Tannery.

Illustrating the immense saving which can often be realized by the use of central-station service, Wm. Schuff & Company, tanners at Louisville, Ky., who recently electrified their plant and contracted for current with the Louisville Gas & Electric Company, have reduced their expenses approximately $225 a month by the change. From this must be deducted interest on the new equipment, but after this is done the result is an impressive argument in favor of this arrangement.

The cost of current as compared with coal has been in favor of the former to the extent of about $80 per month. The boilers are still being used for making steam, which is needed in various manufacturing operations, but two of the four men formerly employed in the power plant have been dispensed with, saving roughly $150 per month. In addition, the concern plans to substitute gas for coal under its boilers, with automatic arrangements which will enable it to do without the services of anyone in that department.

These tanners are driving their special equipment in groups for the most part, the total installation being about 250 horsepower.

Lighting-Rate Controversies Settled.

After agitation and controversy extending nearly two years and after the city had voted for municipal ownership of the lighting plant, the City Council of Port Clinton, O., has reached an agreement with Port Clinton Light & Power Company and the Toledo & Northwestern Railway & Power Company, both controlled by Barstow & Company, of New York City, and closed up a ten-year contract. By the terms of the settlment a maximum rate of eight cents per kilowatt-hour, with a sliding scale down to six cents is secured for domestic current. A feature of the street lighting will be a "white way" with ornamental posts and lights in the business section. Many small lamps will replace the few old arcs.

The city of Springfield, O., and the Springfield Light, Heat & Power Company, have agreed upon the terms of the new rate ordinance under which the company will furnish current to the city and domestic consumers for all purposes. The new ordinance will provide for a flat charge of seven cents per kilowatt-hour, with a minmum net monthly bill of 50 cents. A discount of ten per cent for prompt payment will be allowed. A resetting fee of $1.00 for installing a meter when service has been discontinued is provided for. The company is given the right to contract for local service for a period of not longer than five years. It is stated that the new rates will mean a marked saving to small consumers.

Electric Sign Data

New Motograph Sign in Chicago Largest in World.

The new Motograph sign erected by the Federal Sign System (Electric), at Michigan Avenue and Randolph Street, is one of the largest electric signs ever erected and is the largest of this type of sign in the world. It is 50 feet high and 140 feet long, although 116 feet of this length shows down Michigan Avenue, while 24 feet follows the turn of the building upon which it is erected and shows down Randolph Street. It is open to an unobstructed view of over a mile looking north on Michigan Avenue, facing the entire open space occupied by Grant Park. The letters on the Motograph portion are 12 feet high and the entire sign is easily read over a mile away.

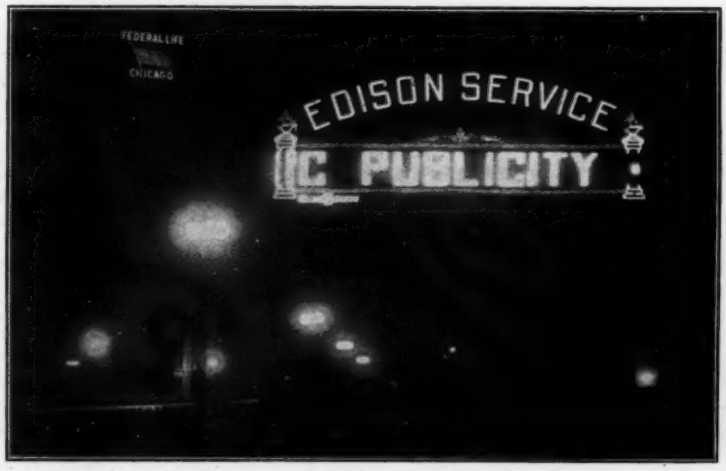
This sign contains approximately 10,000 Mazda lamps of 5 and 10-watt sizes. More than 100,000 feet of wire—about 20 miles—have been used in connecting the points of contact with the individual lamp sockets.

The attention-getting feature is the motograph construction which is operated by a perforated roll having a capacity of about 150 words, moving in a continuous line across the board. The copy is changed every evening. Each roll carries a sales talk describing some particular branch of the company's service. The Motograph feature is operated in a manner very similar to that of a piano-player. The rolls are made of a specially treated paper and the letters or characters are punched by means of a special perforating machine which operates similar to a typewriter. When the sign starts to run, the perforated roll is drawn between the grouped terminals of the thousands of lamps, which are symmetrically arranged all over the central space of the great sign, and the other terminals of the electrical circuit. Small spring contact brushes drop through the passing perforations and momentarily light the corresponding letters on the face of the sign.

Since its erection, the sign has been the feature of the downtown section of Chicago and it has shown its value by the number of people which it forces to stop along the street and on the corners to read its entire message. Reports have been received that it can clearly be read for some distance out upon Lake Michigan, and so far it has proved itself the most desirable publicity possible. The effect of letters of fire 12 feet high running around the corner of a building is something difficult to imagine and truly very humoresque.

The first advertisement on this board is the Commonwealth Edison Company, but national advertisers are contracting for space to be used as soon as the Edison contract expires. Approximately 10,000 lamps are used in the entire sign, including the reading matter Edison Service, which is steady burning above the attraction board and including also a colored lamp border or frame outlining the attraction board.

A sample of the reading matter which the Commonwealth Edison Company is using is as follows: "Electric light, cheapest, cleanest, safest, most modern for the factory, for the mill, for the store, for mansion or cottage, for apartment or tenement. Electric light improves the health, conserves the eyesight. Can be placed exactly where needed. Use as much as you require, pay only for what you get. Commonwealth Edison Company, Contract Department."



Motograph sign erected by the Federal Sign System (Electric), Chicago.

Sign is 50 feet high and 140 feet long. The letters are 12 feet high.

Approximately 10,000 five-watt and 10-watt lamps are used.

Wording appears to enter sign from right and leave at left. Perforated roll is used, having capacity of 150 words.

Wording "Edison Service" burns continuously. Border of sign is of various colors.

The business men of Tarentum, Pa., are now on a campaign of decorations. The streets have been neatly equipped with more electric lights and the portion of Corbet street between Third and Fifth Avenue, is now known as Broadway. Several of the business houses have installed strong lights in front of their store, while other merchants have their places decorated with handsome electric signs. It's the proper spirit and is being adopted on all business streets.

George H. Hartford, of the Cincinnati branch of the Federal Sign System (Electric), landed a handsome contract recently, when arrangements were closed with the Ramsfelder Shoe Company, operating the Traverse string of retail shoe stores, for the erection of electric signs for the Louisville, Dayton, Columbus, Cleveland, Cincinnati, Pittsburgh, Newark, Washington and Baltimore stores. The last four are to be new signs. The largest, 8 by 18 feet, is for Washington.

Electrical Construction

NEW ENGLAND ELECTRICAL CONTRACTORS' CONVENTION.

Worcester, Mass., September 23-24.

Under the auspices of the Electrical Contractors' Association of Massachusetts, a convention of electrical contractors of New England was held at Worcester, Mass., Wednesday and Thursday, September 23 and 24. The headquarters were the Hotel Bancroft, and nearly 300 members of the state association and delegates from all New England, together with guests, were in attendance.

Opening Session.

The first session was called to order by President George D. Gibb, of Dedham, Mass., who praised Worcester for its local association of eleven years' standing, and pointed out the desirability of every contractor belonging to the national association and to state associations. In the absence of Mayor Wright, Alexander B. Campbell, chairman of the Common Council, welcomed the convention to the city and presented the key to Worcester.

W. K. Tuohey, chairman of the Convention Committee, then took charge of the session. He said the progress of the contractors' business in the 25 years of its development had been amazing. He traced its growth from the days of wood cleats, through those of porcelain insulators, to the present time, when iron conduit is in general use, and no new building is planned without a complete electrical equipment.

Mr. Tuohey held that matters pertaining to the contractor's personal interest had been overlooked and that therefore there is great need of organization for co-operation and protection. The contractors have been slow to find this out. They have suffered at the hands of interests. Some jobbers have encroached on their customers' business while some contractors have not always treated jobbers in a fair manner. "When you find a loyal supply house, be loyal to it," said Mr. Tuohey. The advantages of concentrating purchases were pointed out. It was suggested that architects did not sufficiently respect the contractor but Mr. Tuohey thought that the contractor was often to blame for this condition because of allowing profits to be cut.

Praise was accorded various lighting companies, notably those of Worcester and Springfield, for their help to contractors. The chairman referred to the power exerted by the labor unions and through other trade organizations such as that of the master plumbers, which has been able to bring pressure to bear on jobbers so the latter now sell supplies only to the proper parties. The slender returns gained by electrical contractors are due in large part to lack of organization. They are often hostile to one another, talk against their competitors and bring discredit on the business. The remedy for this is the formation of associations in every city, and membership in the state and national associations. "Unite to lift the business to a place of honor," said Mr. Tuohey. "Jealousy and envy will then give way to charity and good will toward your competitors."

Marshall L. Barnes, Troy, N. Y., a former president of the national association, was the next speaker. Sixteen years ago an organization of contractors was formed for Troy and nearby cities. A state association followed, and at the Buffalo Exposition in 1901 the National Association was organized with 37 members. A conspicuous benefit has been the contractors' influence with the National Board of Underwriters. Hitherto the inspector had dominated, but the contractors' interests are now respected and the rules governing wiring are largely the work of Ernest McCleary. Mr. Barnes pointed out the merits of the Universal Data and Sales Book. It is often valuable as a basis for settling disputes. It sets forth a code of standard symbols and defines those used by architects.

The Value of Proper Wiring for Incandescent Lamps.

A technical paper was presented by M. D. Cooper, of the Engineering Department, National Lamp Works of the General Electric Company, Cleveland, O., on "The Value of Proper Wiring for Incandescent Lamps." Mr. Cooper pointed out that the vital factor controlling the service rendered by incandescent lamps is the voltage at which they are operated. If the voltage is too low, they fail to give the proper amount of light, while if the voltage is too high their life is decreased. Central stations often regulate their line voltage by tests made on the customer's premises, often at the service entrance. Hence it is important that the voltage drop between that and the lamps should be kept as low as possible. A decrease of one volt at the terminals of a 110-volt lamp will cause a decrease in candlepower of 3.5 per cent, a decrease in wattage of 1.5 per cent, a decrease in efficiency of 2 per cent, and a decrease in renewal expense of 15 per cent. The latter factor appears at first glance to be a large saving but such is not the case.

A 40-watt lamp during its 1,000 hours' rated life will consume $4.00 worth of current on a 10-cent rate. The lamp costs the customer 30 cents, making a total cost of producing light $4.30 for 1,000 hours. Taking the above mentioned percentages he figured that the decrease in voltage before mentioned means a loss of 4.5 cents to the customer.

The effect of a considerable drop in voltage on the operation of auxiliary appliances is somewhat similar. These appliances require nearly as close voltage selection and regulation as lamps. Flatirons, curling irons, warming pads, etc., are rated by manufacturers in steps of from 5 to 10 volts, showing the satisfactory voltage limits are 2.5 to 5 volts on either side of the rating. Toasters, percolators, broilers, etc., are rated in steps of 3 to 7 volts, the satisfactory voltage limits being 1.5 to 3.5 on each side. If the voltage supplied to device is too low, the time required for heating the device is excessive for satisfactory results, and tends to discourage their use. When accessories are attached to lamp sockets the voltage drop is likely to be excessive, the wiring to the lamps being rarely designed for such heavy loads.

Mr. Cooper gave the results of tests made in a number of buildings in Cleveland, comprising industrial, residential and commercial installations. Simultaneous voltage readings were made at the service switch and at the lamp socket, by means of the use of stop watches. Readings of voltage at the central station were taken every half minute, and at lamp sockets at times corresponding. The tests were made with normal loads, those on residential installations being supplemented by data on drop caused by the addition of flatirons, etc. Twenty-one industrial establishments showed an average maximum voltage drop of 5.02 volts, an aver-

age voltage drop of 2.94 volts, and a total lighting load of 5.1 kilowatts. Twenty stores, hotels and restaurants showed an average maximum drop of 3.94 volts, an average drop of 3.03 volts and a total lighting load of 10.9 kilowatts. Eighteen apartments and 14 houses, with an average load of 547 watts, gave an average maximum voltage drop of 2.08, and an average drop of 1.57 volts. The increment due to accessories ranging from 440 to 1,250 watts was found to produce an average drop of 4.35 volts.

These tests indicate a general condition which is detrimental to the best quality of electric service, said Mr. Cooper. The test in residences indicate that too often insufficient attention is given to the installation of baseboard or wall outlets for the use of such accessories as toasters, vacuum cleaners, flatirons, washing-machines, percolators, cooking utensils, etc. Excessive drop and insufficient outlets entail a loss to everyone who has to do with the installation: to the contractor, who loses on the amount of work to be done and the sale of the copper; to the owner, in the quantity of light, economy of production and the satisfactory and economical use of appliances; to the central station, because of losses in the sale of current. It is hence important that wire large enough to carry the load without excessive drop should be used. The average installation should not be designed for more than one volt drop.

Mr. Cooper presented a table showing the amount of current which circuits of various sizes of wire and various lengths will carry with a drop of one volt, and called attention to the amendment to the Underwriters' Code providing for the use of 750 and 1,000-watt lamps. Rule 72*a* rates the keyless mogul socket at 1,500 watts at 600 volts instead of 660 watts at 250 volts as heretofore. Rule 23*d*, limiting the maximum demand on any one cutout to 660 watts, provides special conditions for the use of the new lamps. In wiring for these lamps, particular care should be exercised to have the wire large enough. Assuming that a 1,000-watt lamp were installed on an 80-foot circuit and that the current were about 9 amperes, No. 8 wire would have to be used to keep the drop down to one volt. If No. 14 wire were used, the resultant drop of 4 volts would cause about a 15-per-cent loss in candlepower.

In concluding, Mr. Cooper pointed out the tendency of unscrupulous or careless contractors to skimp on copper, when bidding is keen through competition. It was urged that the Association bring the subject to the attention of architects, so that specifications may be made to meet the needs of the situation.

G. E. Shepherd on "Leadership."

George E. Shepherd, of Wilkesbarre, Pa., a director of the National Electrical Contractors' Association, spoke on "Leadership." He outlined the early relations which existed between the manufacturers and the central station, by which the contractor was excluded from the field. Now, the contractor has come to be recognized as the proper agency to handle all inside wiring. Some central stations seem to wish to destroy the contractors' business by selling apparatus and doing house wiring at cost or at a loss. Formerly the lighting company held the contractor to be a mere mechanic, and not a business man. With the building up of electrical store business the contractor has come to be an important factor. Many feel that the lighting company should confine itself to the generation and sale of current. The Society for Electrical Development has done much to smooth the differences of opinions existing between contractors and the central station, the speaker said. Co-operation between them is often brought to a close by the lighting company's change of management. The syndicated plants are the hardest to combat. The policy of local companies is determined upon at a distance and has little regard to local sentiment. Many managers of the syndicated companies agree that it would be better not to do a sales business, but their judgment is overridden.

Mr. Shepherd held that price cutting on supplies and appliances results in loss both to the central station and to the contractor. He held that laws should be enacted to prevent central stations doing any outside business.

George W. Hill, special representative of the National Association, set forth the plans for the evening rejuvenation of the Sons of Jove.

President Galloway's Address.

The afternoon session opened with an address by John R. Galloway, of Washington, D. C., president of the National Electrical Contractors' Association. Mr. Galloway was greeted with cheers by his admiring friends. He dwelt principally on the benefits of organization and co-operation. He said the Association's prime objects are to establish uniformity in commercial usages, to build up the business, and to adjust differences between individuals engaged in the trade. Association is a stimulus to ambition as well as a means to dollars and cents, Mr. Galloway asserted.

Value of Association.

Arthur R. Jones, secretary of the contractors' association of Cleveland, O., made a plea for the better co-ordinating of forces. He recognized the difficulties attending the getting of competitors to join hands. Contractors find, on careful study, that their competitors are really their best friends, that the customer and sometimes the jobber is the inimical force. The latter sometimes reduces the price of supplies to a competitive bidder and sometimes does the electrical contracting business great injustice. Mr. Jones showed the need of mutual confidence between the five factors in the electrical field: the manufacturer, jobber, contractor, central station and employee. First, the large minds in the producing field should be looked to to help the contractor. Furthermore, contractors should organize their employees for the best interests of both parties. With union and harmony between masters and men, the force of superior capital can be overbalanced. The contractor will hold the balance of voting power, and can get laws passed, through the co-operation of employees.

The speaker pointed out that it is better for employers to organize their employees than for the latter to enter upon a strike for higher wages. The consumer ultimately pays the higher wage. Educational facilities such as contractors can help provide will enhance the value of the workers. Cleveland contractors are using these methods. One contractor claimed the cost per unit of work done by $5-a-day men was no more than hitherto with wages of $3.50 a day. The overhead expense is likewise no greater. Mr. Jones held that industrial concerns that employ direct labor often find their installation costs more than if they were to employ contractors to handle the work. He cited an instance of a manufacturing company that did direct work and was able to violate local regulation through its political influence. The speaker also pointed out the losses resulting from overcapitalizing.

Mr. Jones urged that a check on quality of work and materials should be kept by means of inspection by agents of contractors' associations. The specifications for wiring should be made very definite to prevent the skimping of material by an unscrupulous bidder who may be awarded the work. Licensing laws will place the responsibility for good work upon the master electrician and eliminate interlopers. Defective wiring is usually due to an incapable contractor. Every employer should keep a record of his men, to insure efficient help. The listing of permits for electrical installation would be a good means of securing business. The speaker urged all contractors present to form local organizations in each town basing them on justice, co-operation and confidence.

When asked if mill electricians would not be eligible for licenses under a licensing law, Mr. Jones replied that master electricians alone should be

licensed, and the term closely defined.

Work of the Society for Electrical Development.

George B. Muldaur, of the Society for Electrical Development, described the aims of that organization. Of the 1,404 members, 581 are contractors, he said. Each member, no matter how large, has but one vote. The speaker showed lists of contractors who have written to the Society for help and suggestions. He gave data on the subject of city ordinances and said the Society had been asked to aid in formulating a scheme of regulation for the general adoption by cities throughout the country. The Society is now seeking the aid of city fire chiefs in not reporting fires as being due to "defective wiring" when there is no other obvious cause. The organization has a set of standard electrical specifications for architects' use, which has been formulated by a foremost electrical engineer.

Among the films of the Society now being shown in the country is one which illustrates the uses of electricity for agricultural purposes. This and another which depicts the amazement of a prisoner just released from a 25-year prison term upon seeing the wonderful achievements of electricity, are being seen by upwards of twelve millions of people, and were issued by the Society for Electrical Development.

The Contractor and the Electrical Code.

Ralph Sweetland, Boston, Mass., secretary of the Rules Committee of the National Board of Fire Underwriters, spoke on "The Relation of the Electrical Code to the Contractor." He said the Underwriters' Laboratory makes tests of all materials that enter into construction, and issues twice yearly a list of the fittings that meet the test. No manufacturer is omitted from the list, and any contractor can find all requisite materials in the list. The Board invites intelligent criticism of its rulings. Mr. Sweetland advised the contractors not to try to meet the cheap contractor, saying, "Good installations are your best advertisement."

The Central Station and the Contractor.

The concluding paper of the day was by Harry D. Learnard, of the Worcester Electric Light Company, on "The Relations Between the Central Station and the Contractor." Mr. Learnard pointed out the interdependence of the manufacturer, contractor, jobber and lighting company, each of whom is a link in the chain of a great and growing industry. The common object therefore should be to create a field for all kinds of apparatus. Central stations have therefore established selling organizations which include solicitors, advertising men and engineers. Apparatus is displayed in the company's show room, the solicitors call upon prospective customers and the advertising men work through the public press. In the case of the contractor, this publicity work is seldom attempted; he is inclined to follow lines of least resistance and take what is offered, the preliminary steps having been taken by the central station. Contractors are loath to enter upon business-getting campaigns because the fruits may be shared in large part by competitors rather than himself. Until all contractors have selling organizations, it seems the most logical thing that the soliciting of business be done by the single agency, the central station, he stated.

After a contract has been let, the contractor has a great opportunity to increase the extent of his work. He is in close touch with the owner, architect, or general contractor and can offer suggestions and push the sale of his product. Thus he assists the central station in return for the service rendered by its selling force. An electrical contractor was cited who, when awarded work, studied the plans and specifications to see if everything was included, and if not, wrote the owner or architect calling attention to added features which seemed to him desirable, as for example, outlets for fans, heating pads, portable lamps or vibrators. By this means he increased his sales of accessories 10 per cent. The public is as yet very ignorant of the uses of electrical devices, said the speaker. This is particularly true of electric heating pads, the use of fans in connection with radiators, electric soldering irons in shops and the electric motor drive in factories, etc. The interesting descriptive circulars issued by manufacturers should be used constantly by contractors.

Mr. Learnard held that contractors maintaining attractive stores will not fail of selling large quantities of supplies, even though the central station show room is larger and has a better assortment. The retail store will enable the contractor to become better acquainted with the customers. The contractor should study costs and keep a semi-annual record of his fixed charges, labor costs per unit and material costs, and reduce prices as business grows, thereby giving the public part of the benefit of increased efficiency.

To assist the contractor the central stations are constantly reducing their rates, and finance contracts for contractors in many cases. The remedy for the interference of the so-called "basket contractor" with legitimate business lies with the contractor, assisted by the central station. Contractors' associations should have quantity agreements with the jobbers. They should give time to rigid inspection. Sometimes it is well to take into the association these "basket contractors," educate them in modern business methods, and show them that gross profit is far from being net profit. It is better to allow cut-rate men to load themselves with unprofitable work than to meet their prices; they will soon either go out of business or come into association with the regular business men.

Mr. Learnard maintained that wherever there is friction between the central station and the contractors it is due to misunderstanding. Every central station is anxious to work with the contractor to promote the common end. He suggested taking into the contractors' associations representatives of the stations as associate or active members, and obtaining from them the policy and system of operating. By this means grievances can be discussed and adjustment made. Jobbers, manufacturers and inspectors should be made associate members. Talks by master builders, architects and engineers on the handling of contracts, efficiency and business getting would be of great help. The largest amount of publicity in bidding and the awarding of sub-contracts by the general contractor will result in benefit to all. The contractor who is doing work at cost can be shown the folly of his course.

The speaker suggested that the problem of central-station merchandising may work out in the same manner as the business of inside wiring. At first it was necessary for central stations to do this work, but gradually it became a separate business.

Central stations of Massachusetts represent a capital outlay of some $50,000,000. The selling organizations are at the contractors' disposal to assist in selling their product.

The evening was given to a rejuvenation by the Jovian order, the degrees being worked by members of the Pittsfield organization.

Auditing and Accounting.

President Gibb was chairman of the session of Friday morning. Arthur R. Jones, of Cleveland, O., an expert accountant, made an address on "Auditing and Accounting." Mr. Jones said the system formulated by the National Electrical Contractors' Association is about ideal. Uniformity in accounting is valuable. Public authorities are liable to demand the inspection of books. By the prescribed method the contractor will know his ground and will not be tempted to trim his profits to the vanishing point. Overhead costs should be reckoned at 15 per cent of gross business, which should run yearly six or seven times the amount of a firm's capital investment. The factors in the business are (1) production: labor, material and overhead; (2) man-

agement: salaries, accounting, purchasing; (3) selling factors; (4) profits. The division of gross contracts averages: labor, 30 per cent; material, 45 per cent; profit, 10 per cent; overhead, 15 per cent.

In Cleveland, investment in the business is out of proportion to gross business done. The former is $350,000 while the yearly business of 1913 was but $1,250,000, or less than four times the capital. In any community each new competitor lowers profits in that he adds to the capital investment. Associations should bring about consolidations of companies and the eliminating of competing factors that are detrimental to the general trade. They should discuss costs in public meetings, and get at fair working bases.

E. P. Baker, of Providence, R. I., said, of 90 reports to the National Association, the overhead given ranged from 19 to 29 per cent.

G. W. Hill said the state association of Illinois has found that in businesses of $15,000 to $20,000 sales, the overhead averaged 26.25 per cent. His own investigations have shown that 20 per cent is about the average for the country at large.

Mr. Baker said 21 per cent is his own overhead figure.

C. T. Arnold, Providence, R. I., asked how contractors should treat stock on which a fixed commission is set by the manufacturer; to which Mr. Jones replied that the manufacturer should be brought to increase the commission. Co-operation in bookkeeping was an added suggestion, it being the idea for eight or ten firms to join in employing an expert and dividing the expense.

Legislation.

A. J. Hixon, of Boston, Mass., a director of the National Association, spoke on "Legislation." He hoped for concrete results from this first New England convention. Make it a yearly affair, he urged. His paper dealt with the need of licensing laws and laws governing the letting of separate contracts. Who is responsible for the safety of installations? he asked. The present laws are conflicting on this point, sometimes designating the workman, the contractor and the customer. The discrepancies between local ordinances and insurance regulations should be harmonized.

The activities of electricians should be regulated by a license based on ability and responsibility, with a severe penalty for infraction. The enforcement should lie with the state, which should be the source of the license. Enforcement should be mandatory upon the police of towns and cities. Secondly, legislation should be nation-wide to compel public officials to award subordinate contracts for public work separately. New York, New Jersey and Pennsylvania have such a law. The American Society of Architects has condemned unit contracts. Every electrical contractor should bring pressure to bear on the Legislatures of New England to remedy present evils.

A proposed license law failed of enactment in Massachusetts last session because of lack of unanimity on the form of the bill. Contractors will unite on the bill to be introduced in the next session. Another bill will be pushed by four associations jointly to secure the awarding of separate public contracts.

Mr. Hixon moved that the president appoint four committees of three members each, on Accounting and Cost Keeping, Legislation, National Code, and Labor Committee. This motion was seconded by F. L. Barnes, of Boston, and carried.

President Galloway urged measures looking to the separation of contracts. "Don't divide profits with the general contractor," he urged.

Election of Officers.

New officers were elected as follows: president, W. K. Tuohey, Springfield, Mass.; vice-president, C. W. Stiles, Milton, Mass.; secretary, H. D. Temple, Worcester, Mass.; treasurer, F. L. Barnes, Boston, Mass.; directors, Samuel Cook, Northampton, Mass., and G. D. Gibb, Dedham, Mass.

M. L. Barnes emphasized the social side of association work while G. W. Hill said this was the best convention he had ever attended. He hoped a state association would be formed in every New England state. He called attention to the rule which makes every member of the National Association a member of a state association without further fees. The initiation is $10, and the assessment $8 a year. Many new members were enrolled.

Thursday afternoon was given to a sightseeing trip to the Insulating Department of the American Steel & Wire Company, the station of the Worcester Electric Light Company and the Worcester Polytechnic Institute. In the evening a banquet was held, with E. W. Ham, of Worcester, as toastmaster, and informal remarks by leading members of the trade. It was decided to hold the 1915 convention at Springfield.

Exhibits.

The following manufacturers, agents and jobbers exhibited during the convention:

Holtzer-Cabot Electric Company, Brookline, Mass., telephone sets, motors, signal bells.

Worcester Electric & Manufacturing Company, Worcester, Mass., switches and panel boards.

Pettingell-Andrews Company, Boston, Mass., household appliances, lamps, fixtures.

Bryant Electric Company, Bridgeport, Conn., new hospital signalling system, wiring devices.

M. W. Dunton Company, Providence, R. I., friction tapes, "Nokorode," rubber gloves.

Culver-Stearns Manufacturing Company, Worcester, Mass., auto lighting specialties.

Crouse-Hinds Company, Syracuse, N. Y., wiring specialties.

Trumbull Electric Manufacturing Company, Plainville, Conn., panel board, armored cable and specialties.

American Model & Instrument Company, Worcester, Mass., "Amico" calling and fire-alarm system.

Landers, Frary & Clark, New Britain, Conn., domestic appliances.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., fans and domestic appliances.

Bancroft Electric Company, Worcester, Mass., agent for Western Electric Company, New York City, ranges, irons, vacuum cleaners.

E. R. Bryant, Boston, Mass., wiring specialties.

Albert Mann, Boston, Mass., contractors' supplies.

Condit Electric Manufacturing Company, Boston, Mass., cable, switches, fuses, circuit breakers.

S. B. Condit, Jr., Company, Boston, Mass., safety armorite cable, conduit, wiring specialties, Arrow Electric Company products.

H. T. Paiste Company, Philadelphia, Pa., wiring specialties.

McGill Manufacturing Company, Valparaiso, Ind., specialties.

Among the Contractors.

The Sterling Electric Company, Minneapolis, Minn., has secured the electrical contract, amounting to $5,300, covering the installation of light and power in the National Biscuit Company's buildings, which are being remodeled.

Eardley Brothers, of Salt Lake City, have recently obtained a contract for equipping the new Windsor Hotel which is being remodeled and refitted by A. Fred Wey, formerly manager of the Wilson Hotel. Special Brascolite fixtures will be used throughout the lobby, corridors, and public places of the hotel. The contract includes the installation of an animated electric sign.

Blaine Grey and Alvin Sessions, formerly employed by Eardley Brothers, Salt Lake City, Utah, have recently resigned their positions with that firm to open up a business in the Keith Emporium in that city to be known as the Keith Emporium Electric Company.

National Association of Electrical Inspectors.

THOMAS HENRY DAY, President, 59 Deerfield Avenue, Hartford, Conn.
H. S. WYNKOOP, Vice-President, Municipal Building, New York, N. Y.
WILLIAM LINCOLN SMITH, Secretary and Treasurer, Concord, Mass.
JAMES E. COLE, Representative on Electrical Committee of National Fire Protection Association, City Hall Annex, Boston, Mass.

Executive Committee
EUGENE N. DAVIS, Chairman, Brookline, Mass.

SECTION REPRESENTATIVES:
C. H. Fletcher, H. Burnes, British Columbia.
A. W. Hopkins, G. W. Perry, Western New England.
Washington Devereux, A. H. Lilley, Philadelphia.
E. N. Davis, H. A. Knight, Eastern Massachusetts.
C. A. Hannan, O. E. Smith, New York City.
C. W. Mitchell, John W. Carrell, California.

MEMBERS AT LARGE:
George L. Collison, Frank R. Daniel, James H. Fenton, F. G. Hartwell, J. E. Latta, James B. McCarthy, Thomas D. MacColl, A. A. Moffitt, R. P. Strong

"LET THE CODE DECIDE."

The matter appearing in this section consists of questions on the National Electrical Code, its interpretation and meaning, and questions as to whether certain methods of wiring are in accord therewith. These questions are gladly received from anyone interested, even if not a member; they should be sent to the secretary with any needed elucidating sketch. They are answered by each member of the Executive Committee according to his knowledge of what the ruling would be in his jurisdiction.

It should be understood that no pretense is made to give an authoritative interpretation of the Code. This is a voluntary association; it has representation on the Electrical Committee of the National Fire Protection Association, which prepares the Code, but it has no right, and claims no right, to give a final interpretation of anything in the Code. It is only intended to give the interpretation which seems correct to the members of the Executive Committee. No attempt is made to edit or correlate the answers from the different members of the Committee, as it is felt that the occasional difference of opinion is calculated to lead to a further study of the matter in question, further discussion and the final clearing up of obscure points.

The aim is to help toward a better understanding of the Code on the part of all; a more uniform conception of its meaning; increased precision in applying it; and harmonious action of those using it, for the common good.

Necessity for Insulating Joint With Chain Fixture.

Question 274. Would you consider that Rule 30*a* had been complied with if the insulating joint were omitted where a chain fixture six feet long is suspended from a conduit outlet, the outlet being controlled by a switch (the fixture being too high to reach from the floor) and the cord used being No. 16 with three-sixty-fourths-inch rubber and a common brass-shell socket being used.

Answer 1(U). Yes.

Answer 2(T). Rule 30 does not permit this construction.

Answer 3(B). Method suggested would not comply with the rule as it reads nor with the intent of the rule when same was adopted.

Answer 4(F). No, the common brass-shell socket would not be approved when placed on a fixture directly connected to a piping system without an insulating joint. The rule plainly requires porcelain sockets or equivalent.

Answer 5(P). No, the insulating joint may be omitted only where the socket lining is equivalent to that in a porcelain socket.

Answer 6(H). No. It will also be impossible to weave double-braid wire through the links in the chain.

Answer 7(E). The fact that the fixture is switch-controlled is not a part of the problem, neither is the gauge of the flexible conductors within the influence of the rule referred to. In a straight electric fixture, on a conduit, armored-cable or metal-moulding system, the insulating joint may be omitted if the conductors have insulation which is the equivalent of the insulation in the other parts of the system, which insulation should never be less than three-sixty-fourths-inch. I should suggest that a more explicit explanation of the phrase "and common shell socket" be requested of the gentleman who asks this question.

Answer 8(R). Yes, if the No. 16 wire is N. E. Code 600-volt standard.

Answer 9(Y). It would require an approved socket as provided for in Rule 30*a*.

Answer 10(V). A brass socket of ordinary type would not answer the intent of Rule 30 as the insulation between the contacts and the brass shell is not the equivalent of the conductors that feed it.

Answer 11(A). Rule 30*a* does not contemplate fixtures installed in this way. Under the rule the wire must have the same insulation to the lamp. In the question the size of wires as well as of the insulation is changed. While there might not be any trouble from a fixture installed in this way I do not think it would be wise to start installing them in this manner.

Answer 12(S). No, the distance from the floor does not enter in. The socket is not the equivalent of porcelain.

Answer 13(O). The insulation of three-sixty-fourths-inch new-code rubber would seem to comply with the requirements for fixtures where the insulating joints are omitted but the ordinary brass-shell socket has not "porcelain or equivalent insulation, etc.," and therefore would not be approved on such a fixture.

Answer 14(N). In this question I do not see that the length of the fixture is material, neither is the fact that it is so far from the floor that it has to be controlled by a switch except so far as this indicates that it is a keyless socket that is used. So far as the wire goes the fact of its being No. 16 gauge does not count as that is considered to be properly protected by the same fuse as protects No. 14 wire, at least by implication, No. 18 wire being so considered in some cases. Three-sixty-fourths-inch insulation of rubber is sufficient as that is equal to new-code 600-volt wire in small sizes. We need not consider the fact that it may be single braid whereas the conduit wire is double braid because the extra braid is worthless for insulation and serves only for protection against abrasion while drawing in. Thus, except for the socket, everything is acceptable. Now I take it that the socket requirement of Rule 30*a* is to guard against leakage from the current-carrying parts onto the metal of the fixture and thence to the conduit, and so to ground. Hence, if the socket is so held that it cannot make metallic connection with the fixture, there are no objectionable

features, for, of course, so far as the socket itself is concerned, the brass shell is acceptable. If, then, the socket is so supported that it is in contact with any metallic part of the fixture, the brass-shell socket is not to be approved; if, on the other hand, the socket is entirely insulated from the fixture, it should be approved.

To illustrate, I have a chain-supported ring fixture which holds an inverted glass bowl. Supported from the ring is a three-legged collar which clamps the socket and holds the lamp in place. In this case the socket must be porcelain or equivalent if the insulating joint is omitted. Now, suppose I replace this spider with one having much shorter legs and a wider opening so as to hold by the rim a prismatic glass reflector and that in the center of this glass reflector there is an opening through which the socket passes and to which it is held by the usual small ring clamp. In this case the brass-shell socket *must* be accepted because it is not in electrical contact with the fixture proper and cannot become so since, if anything breaks, it will simply drop into the bottom of the bowl, or, if not, it will swing clear, the lamp bulb itself hitting the spider frame which is lower than the end of the socket on account of the slope of the reflector.

Possibly it might be claimed that Rule 77*c* prevented this arrangement but then I should argue that the socket was on pendant cord unless the wire was interwoven in the chain. Even then the rule does not say the socket "except when supported on pendant cord or by pendant cord," but simply "when on pendant cord." The purpose of the rule I take to be to guard against supporting the weight of a socket and lamp by a weak fixture wire.

Fixture-Wire Insulation.

Question 275. Does the portion of Rule 30*a*, reading "in which the insulation of conductors is the equivalent of insulation in other parts of the system," allow the use of wire of No. 16 or No. 18 gauge provided the insulation is the same as for conduit work, namely, three-sixty-fourths of an inch?

Answer 1(U). Yes.

Answer 2(T). No.

Answer 3(B). The portion of Rule 30*a* quoted makes no reference as to the size of the conductor, but refers only to the quality of the insulation. Providing conditions are such as would permit the use of those sizes and that they conform to code requirements the same might be used, providing the insulation met the requirements.

Answer 4(F). Yes. In this case the requirement is far better than the ordinary fixture-wire insulation on account of the insulating joint being omitted and causing electrical stress between the fixture wires and the metal of the fixture.

Answer 5(P). Yes.

Answer 6(H). Yes, if the double-braid wire were used.

Answer 7(E). Yes, on fixtures in which the insulating joints have been omitted under the conditions expressed in this section of Rule 30.

Answer 8(R). Yes, this rule is intended to permit the use of any approved wire insulated for 600 volts.

Answer 9(Y). Yes, provided it is used for wiring of fixtures only.

Answer 10(V). Yes, provided, of course, that the load is not greater than the wire can carry safely.

Answer 11(A). Yes, for fixture work.

Answer 12(S). Yes.

Answer 13(O). No. 18 and No. 16 conductors are not prohibited provided insulation is equivalent to that on the conduit wire.

Answer 14(N). Yes. Refer back to my answer to Question 273.

Equivalent Insulation of Sockets.

Question 276. Are common brass-shell sockets considered the "equivalent insulation" of porcelain as applied in Rule 30?

Answer 1(U). I should so consider them because Rule 72*p* says that sockets of porcelain must conform to the same requirement as brass-shell sockets.

Answer 2(T). Rule 30 bars out common brass-shell sockets, that is, those which do not have a porcelain wall completely encircling all live parts and insulating the brass shell if there be one.

Answer 3(B). No, they should not be so considered.

Answer 4(F). No, the fiber lining of brass-shell sockets cannot be considered the equivalent of porcelain.

Answer 5(P). Rule 30*a* is phrased particularly to distinguish between a porcelain socket and one with the ordinary paper lining.

Answer 6(H). No, see fine print note to Rule 72*d*.

Answer 7(R). Yes, under Rule 72*p*.

Answer 8(Y). No.

Answer 9(V). No, the porcelain socket tests far above the brass-shell paper-lined socket.

Answer 10(A). No.

Answer 11(S). I do not so consider it and would not approve the same.

Answer 12(O). Brass-shell fiber-lined sockets cannot be approved on grounded fixtures.

Answer 13(E). I am uncertain what is meant by "common shell sockets." I would not consider the fiber-lined shell sockets as being the equivalent of porcelain insulation between the live metal parts and the shell.

Answer 14(N). I think the evident intent of Rule 30*a* is to rule out the fiber-lined shell socket on grounded fixtures.

Electrical Exports for July.

The Bureau of Foreign and Domestic Commerce, Washington, D. C., has published its monthly summary of the imports and exports of the United States during July. From this are obtained the following data on the electrical exports during that month.

As compared with the relatively low total of the electrical shipments in June ($1,450,437) the total in July shows a further slight decrease. The falling off as compared with July of a year ago is very striking, however, all classes of electrical exports but two showing shrinkage. The government report for July opens a new fiscal year and at this time an additional class has been included in the detailed electrical figures, namely, meters and other measuring instruments. The numbers of articles shipped in the four classes for which numbers are reported were as follows in July: Fans, 1,851; arc lamps, 86; carbon lamps, 20,424; metal-filament lamps, 49,583.

Articles.	July, 1914.	July, 1913.
Batteries	$ 59,714	44,084
Dynamos or generators	195,983	246,595
Fans	23,629	40,217
Insulated wire and cables	127,697	147,948
Interior wiring supplies, etc. (including fixtures)	45,077	68,695
Lamps—		
Arc	1,672	16,423
Carbon-filament	3,143	22,582
Metal-filament	13,581	36,847
Meters and other measuring instruments	31,585	.....
Motors	161,798	501,783
Static transformers	72,443	207,314
Telegraph instruments (including wireless apparatus)	5,340	3,402
Telephones	59,347	77,969
All other	614,351	910,643
Total	$1,415,360	$2,318,502

Public Service Commissions

Conducted by William J. Norton

CALIFORNIA.

The San Joaquin Light and Power Corporation was authorized to renew promissory notes totaling $64,156.48 for a period not to exceed one year.

The Southern California Edison Company was authorized to sell $187,000 face value of its bonds at not less than 87.5, the proceeds to be used for discharging a note of $150,000 outstanding. Any remainder will be turned into the company's treasury to be used as the Commission may prescribe.

ILLINOIS.

Reports of Decisions. All orders of the Commission issued for the period January 1, 1914 to May 1, 1914 have been published in pamphlet form.

The Monmouth Public Service Company has been authorized to put into effect a revised schedule of rates for electric service in Kirkwood. The new schedule provides for a reduction in power rates and establishes a rate for electric cooking service on a separate meter.

The Fayette Home Telephone Company. The Commission finds that service has been made satisfactory in compliance with a former order in which action on rates was deferred until the service conditions should be improved. The present schedule affords insufficient revenue and a substantial increase in rates is authorized.

The City Telephone Exchange of Barry was authorized to put into effect a revised schedule of rates in order to eliminate certain discriminatory charges.

The Central Illinois Light Company was granted authority to issue its first and refunding 30-year five-per-cent gold bonds of the par value of $3,265,000 and to execute a mortgage as security. The proceeds are to be used to purchase electric properties in Farmington, Eureka and Elmwood, to retire $15,000 of bonds, as collateral for notes, and to reimburse the company for permanent extensions, enlargements and additions to its property.

The Greenup Telephone Company was ordered to discontinue free and reduced rate service furnished to the city and individual customers. The order was rendered upon application of the company and set aside the petition of the mayor for the continuance of the free service to the city.

NEW JERSEY.

The New Egypt Light, Heat, Power and Water Company has been authorized to put into effect a new schedule of rates.

OHIO.

The Ohio Service Company was authorized to issue $630,000 of capital stock, the proceeds to be used in purchasing property of the New Midland Power and Traction Company, the County Electric Company, and the Lafayette Light and Power Company as previously authorized by the Commission.

PENNSYLVANIA.

General Order. The Commission has issued an order regulating the crossing of facilities of one public service company by those of another public service company. This order supersedes general order, as of January 8, 1914, upon the same subject, and applies to such crossings other than those between railroads and street railways.

WISCONSIN.

The Mineral Point Telephone Company was denied authority to increase its one-party business and residence rates. It was found that after properly distinguishing between current and permanent expenses that the utility was earning a fair return on its investment.

The Diamond Grove Telephone Company made application for an order compelling the Mineral Point Telephone Company to give physical connection service. The Commission refused to grant the order and points out that the applicant has not as yet built its line to Mineral Point and that when this is done it can effect a physical connection with the Mineral Point company in accordance with the Commission's ruling of June 8th which order provided among other things that rural lines could receive Mineral Point connections at a rate of $2.00 per subscriber per year provided they built metallic lines and properly maintained them.

The Manitowoc Municipal Water and Light Plant were permitted to adjust certain portions of their rate schedules. The Commission authorized a service charge of $1.00 per horse power per month for power service but established a limiting rate of ten cents per kilowatt-hour so that the establishment of the service charge might not seriously affect the charges made at the present time to individual consumers.

The Hubertus Telephone Company has been ordered to employ a competent lineman to repair its lines and so maintain them as to give adequate service in conformity with the standards for telephone service prescribed by the Commission.

Physical Connection of Telephone Lines. The Commission, after a complete investigation of the telephone situation in and around the city of Darlington in LaFayette County, ordered physical connection between the toll lines of the Wisconsin Telephone Company and the exchange in Darlington operated jointly by the Belmont & Pleasant View Telephone Company, the Iowa & LaFayette County Telephone Company, and the Willow Springs Telephone Company. A request for physical connection between these companies and the LaFayette County Telephone Company was denied, as service can be obtained indirectly through the toll connection ordered. The Wisconsin Telephone Company had asked that a uniform rate be made for this territory which would be applicable to all companies alike. The Commission pointed out that, although there is some competition, it is not active, and the proceeding in the matter of rates was dismissed.

Berlin Public Service Company. Upon investigation, the commission found that the company's gas and electric schedules were discriminatory and did not afford a reasonable return on the total investment in the property. A revision of rates was made and the one-meter system for gas was ordered in effect, thus obviating the necessity for a differential between gas used for cooking and for lighting purposes. The general effect of the Commission's order is a slight increase in the company's revenue.

The Berlin Telephone Company was authorized to issue $1,250 of stock to be sold at par, the proceeds to be used in making extensions and additions to the company's plant.

Electrical Engineering Problems.

By R. G. Hudson and W. V. Lyon.

DIRECT CURRENTS.

Problem 4.

A copper wire, five miles in length, has a diameter of 0.25 inch. Standard annealed copper at 25 degrees centigrade has a specific resistance of 10.6 ohms per mil-foot, and a temperature-coefficient of resistance of 0.00385 per degree centigrade.

Find (*a*) the diameter of the wire in mils; (*b*) the area in circular mils; (*c*) the weight in pounds; (*d*) the resistance at 25 degrees centigrade; (*e*) the resistance at 50 degrees centigrade, and (*f*) the temperature of the wire when the resistance is 4.80 ohms.

SOLUTION OF PROBLEM 4.

A *mil* is a unit of length, and equals 0.001 of an inch.

Answer to Question a.

0.250 inch=250/1000 inch or 250 mils.

A *circular mil* is a unit of area and equals the area of a circle one mil in diameter. The area (A) of a circle in circular mils equals the square of its diameter (D) measured in mils, or

[14] $A=D^2$ circular mils.

Answer to Question b.

[14] $A=(250)^2=62,500$ circular mils.

The weight (G) of a copper wire in pounds is given by

[15] $G=3.03Al/10^6$ pounds

(A) being measured in circular mils and (l) in feet.

Answer to Question c.

By [15] $G=3.03\times62,500\times5\times5,280/10^6=$ 5,000 pounds.

The resistance (R) of a standard annealed copper wire at 250 degrees centigrade, (l) feet in length and (A) circular mils in area, is given by

[16] $R=10.6\ l/A$ ohms.

Answer to Question d.

By [16] $R=10.6\times5,280\times5/62,500=4.48$

Given the resistance (R_{25}) of a copper wire at 25 degrees centigrade, the resistance (R_t) of the wire at any other temperature (t) is given by

[17] $R_t=R_{25}\ [1+.00385\ (t-25)]$

Answer to Question e.

By [17] $R_t=4.48\ (1+.00385\ [50-25])$
$=4.48(1+.096)=4.91$ ohms.

Given the resistance (R_{t_1}) of a copper wire at a known temperature (t_1) degrees centigrade, and the resistance (R_{t_2}) of the same wire at an unknown temperature (t_2) degrees centigrade, (t_2) may be determined from

[18] $t_2-t_1=(234+t_1)\ (R_{t_2}/R_{t_1}-1)$

The formula gives the difference in the two temperatures so that in its application to electrical machinery the temperature rise may be calculated directly.

Answer to Question f.

The temperature rise is:

By [18] $t_2-t_1=(234+25)\ (4.80/4.48-1)$
$=(259)\ (.071)=18.4°C.$

and $t_2=25+18.4=43.4°C.$

In the United States, the sizes of wires used for electrical purposes are indicated by the Brown & Sharpe gauge numbers for wires of 460 mils or less in diameter, and by the area in circular mils for wires exceeding 460 mils in diameter.

In the following table, the resistances per 1,000 feet at 25 degrees centigrade; the carrying capacities, and the weights per 1,000 feet are given for the *available* standard sizes of copper wire. This table should be preserved as the size of

Copper Wire Table.

Solid wires are not made larger than No. 0000. A solid wire larger than a No. 3 is infrequently used, and the constants for wires larger than a No. 3 are given for stranded wires. Although wires are sometimes used as large as 2,000,000 circular mils, wires larger than 1,000,000 circular mils are not common, and are omitted from the table. The carrying capacities are those prescribed by the National Electrical Code.

Gage Number	Area in circular mils	Resistance in ohms per 1,000 feet at 25° C.	Carrying Capacity in amperes		Weight in pounds per 1,000 feet
			Rubber Insulation	Other Insulation	
18	1,620	6.51	3	5	4.92
16	2,580	4.09	6	10	7.82
14	4,110	2.58	15	20	12.4
12	6,530	1.62	20	25	19.8
10	10,400	1.02	25	30	31.4
8	16,500	0.641	35	50	50.0
6	26,300	0.403	50	70	79.5
5	33,100	0.320	55	80	100.
4	41,700	0.253	70	90	126.
3	52,600	0.201	80	100	159.
2	66,400	0.163	90	125	205.
1	83,700	0.129	100	150	258.
0	106,000	0.102	125	200	326.
00	133,000	0.0811	150	225	411.
000	168,000	0.0643	175	275	518.
0000	212,000	0.0510	225	325	653.
	250,000	0.0432	240	350	772.
	300,000	0.0360	275	400	926.
	400,000	0.0270	325	500	1240.
	500,000	0.0216	400	600	1540.
	600,000	0.0180	450	680	1850.
	700,000	0.0154	500	760	2160.
	800,000	0.0135	550	840	2470.
	900,000	0.0120	600	920	2780.
	1,000,000	0.0108	650	1,000	3090.

ALTERNATING CURRENTS.

Problem 54.

A 20-horsepower, single-phase, compensated motor is operated at some distance from the source of supply and receives its power over a line which has a total resistance of 0.374 ohm and a total reactance of 0.421 ohm at the rated frequency of 60 cycles. The line voltage at this source of supply is 236 volts and the current and power supplied to the line at this point are 76.2 amperes and 16.6 kilowatts. Draw a vector diagram showing the current, the voltages at each end of the line and the line drop. (*a*) What is the resistance drop in the line; (*b*) what is the reactance drop in the line; (*c*) what is the impedance drop in the line; (*d*) what is the line voltage at the motor; (*e*) at what power-factor does the motor operate; (*f*) what power does the motor take from the line.

all wires referred to in the problems which follow will be stated either in B. & S. gauge numbers, or in circular mils.

SOLUTION OF PROBLEM 54.

The practical way of adding two voltages which act in series in the same circuit is by the method of vectors. See Fig. 3a.

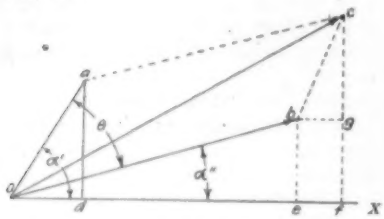


Fig. 3a.

Draw a line, or vector, (oa), which by its length represents the first voltage to scale, and a line (ob), which represents the second voltage to scale. The angle (Θ) between them is the *phase displacement* of the voltages. The diagonal of the parallelogram (oc) is the sum of the voltages. It may be calculated in two ways, of which the second is usually the preferable one to use.

$$\mathbf{E}_0=\mathbf{E}_1+\mathbf{E}_2$$

The boldface letters indicate that the voltages are being added *vectorially* and *not* numerically.

[18a] $$E_0=\sqrt{(E_1^2+E_2^2+2E_1E_2\cos\Theta)}$$

The second method of finding the sum of two or more voltages is by resolving each vector into two components, one along some chosen axis, such as OX, and the other component perpendicular to the axis (See Fig. 3a). Thus the first voltage vector which is represented by (oa) is resolved into the two components (od) and (ad). The point (d) is found by drawing a line from (a) perpendicular to the axis (OX). Likewise the second voltage vector is resolved into two components (oe) and (be). The component of the resultant voltage (oc) which lies along the axis is equal to the sum of the components of the separate voltages along the axis, that is, $of=oe+od$. The component of the resultant voltage (oc), which is perpendicular to the axis is equal to the sum of the perpendicular components of the separate voltages; that is, $cf=be+ad$. The value of the resultant voltage is equal to the square-root of the sum of the squares of its two components, that is,

$$E_0=oc=\sqrt{(of)^2+(cf)^2}$$

If the angles that the voltages make with the axis are known, the horizontal and vertical components can be found as follows:

$$od=(oa)\cos\alpha'$$
$$ad=(oa)\sin\alpha'$$

These relations are expressed by formulas, thus:

$E_h'=E'\cos\alpha'$=horizontal component of first voltage (E').

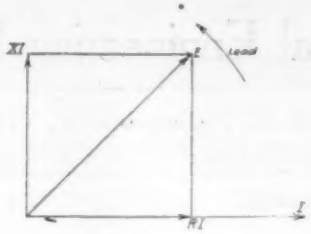


Fig. 4a.

α' is the angle that the first voltage (E') makes with the horizontal axis.

[19a] $$E_h=E_h'+E_h''+E_h'''$$
$$E_v=E_v'+E_v''+E_v'''$$

E_h *and* E_v are the horizontal and vertical components of the resultant voltage (E).

[20a] $$E=\sqrt{(E_h^2+E_v^2)}$$

[21a] $$\cos\Phi=E_h/E.$$

where Φ is the angle that the resultant

DIRECT CURRENTS.

Problem 5.

Energy is transmitted from a switchboard to a lamp and motor load as shown in Fig. 4.

Two No. 1 wires each 600 feet in length connect the load to the switchboard. The parallel-connected group of lamps takes 20 amperes from the line wires, while the motor connected in parallel with the lamps takes 30 amperes from the line wires. The voltage between the line wires at the switchboard is maintained constant at 125 volts.

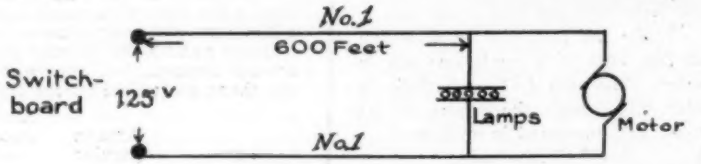


Fig. 4.

Find (a) the power supplied to the lamps, (b) the power supplied to the motor, (c) the power lost in the line, (d) the total power taken from the switchboard, (e) the efficiency of transmission, (f) the energy taken from the switchboard in 8 hours, and (g) the cost of the energy supplied to the system in 8 hours if a kilowatt-hour costs 10 cents.

This problem is given to illustrate the principles involved in the calculation of power and energy.

ALTERNATING CURRENTS.

Problem 55.

A certain part of a manufacturing plant which requires power for both lighting and single-phase motors is supplied over a separate line from the power house. In order that the voltage at the load may be kept constant without affecting any other circuit, this line is supplied with power by an independent single-phase alternator. The calculated resistance and reactance of the line of 60 cycles are 0.0128 ohm and 0.0131 ohm respectively. The lighting load consists of incandescent lamps which take 30 kilowatts at their rated voltage, viz., 110 volts. The single-phase motors take 45 kilowatts at the same voltage and operate at 92 per cent power-factor. This motor load is on continuously but the lighting load begins at four o'clock. (a) What is the total current supplied after four o'clock; (b) what is the resultant power-factor of the lighting and power loads at this time; (c) if the terminal voltage of the alternator is adjusted so that the voltage at the load is maintained constant at 110 volts, what are its values before and after four o'clock; (d) at what power-factor does the alternator operate after four o'clock?

Solutions of the above problems and two new problems will be printed in the next issue.

voltage makes with the horizontal axis.

When a current flows in any circuit that has resistance and reactance, as in a transmission line, for example, the total voltage drop can be divided into two components. One of these is in phase with the current and the other leads the current by 90 degrees. See Fig. 4a.

[22a] The resistance drop in volts (RI) equals the product of the resistance, (R) expressed in ohms and the current (I) expressed in amperes. It is always in phase with the current.

[23a] The reactance drop in voltage (XI), equals the product of the reactance (X), expressed in ohms, and the current (I), expressed in amperes. If the reactance is due to inductance, the drop always leads the current by 90 degrees.

[24a] The impedance drop in volts is equal to the product of the impedance (Z), expressed in ohms, and the current (I), expressed in amperes. See formula [5a] for impedance.

In series circuits, such as we have in this case, it is best to draw the current vector along the horizontal axis.

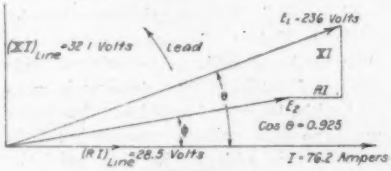


Fig. 5a.

Answer to Question a.

By [22a] $(RI)_{Line}$
$=0.374\times76.2$ $=28.5$ volts

It is drawn in phase with the current.

Answer to Question b.

By [23a] $(XI)_{Line}=0.421\times76.2$
$=32.1$ volts.

It is drawn 90 degrees ahead of the current.

Answer to Question c.

By [5a] Z_{Line}
$=\sqrt{(0.374^2+0.421^2)}$
$=0.563$ ohm.

By [24a] $(ZI)_{Line}$
$=0.563\times76.2$ $=42.9$ volts.

Answer to Question d.

By [3a]

P.-F. at source $=16,600/(236\times76.2)$
$=0.925$
Cos $\Theta=0.925$
Sin $\Theta=\sqrt{(1-0.925^2)}$
$=0.379$

The two components of the applied pressure are:

$E_h=236\times0.925=218$ volts.
$E_v=236\times0.379=89.6$ volts.

The line pressure at the motor, E_2, is the vector difference of the line pressure at the source of supply, E_1, and the drop in the line conductors, IZ.

By [19a]

Horizontal component of $E_2=218-28.5$
$=189$ volts.
Vertical component of $E_2=89.6-32.1$
$=57.5$ volts.

By [20a] $E_2=\sqrt{(189^2+57.5^2)}$
$=198$ volts.

Answer to Question e.

The power-factor is the cosine of the angle of phase displacement of the current and the voltage at the motor. Since the current was taken along the horizontal axis, the power-factor is the horizontal component of E_2 divided by E_2.

By [21a] $PF=\text{Cos }\Phi=189/198$
$=0.955$

Answer to Question f.

By [2a] $P=198\times76.2\times0.955$
$=14,400$ watts.

The power may be found by subtracting the copper loss in the line conductors from the power delivered to the line at the source.

By [4a] $I^2R=76.2^2\times0.374$
$=2,170$ watts
$P=16,600-2,170$
$=14,400$ watts.

INDIANA ELECTRIC LIGHT ASSOCIATION.

Annual Convention, Indianapolis, September 23 and 24.

The sixth annual convention of the Indiana Electric Light Association was held at the Hotel Severin, Indianapolis, on September 23 and 24. The convention was the best ever held by this association, which has increased its strength and prestige very markedly during the past year. The attendance was exceptionally good, and the closest attention was given to both the presentation and discussion of the papers presented. The convention consisted of four business sessions, which consumed practically all of the two days available. Time was left for only one entertainment feature, which was the banquet and cabaret on the evening of the closing day.

The first session was opened on Wednesday morning by President Thomas F. English, of Muncie. He immediately started the program by reading the annual presidential address. In this he urged the members of the Association to pay increased attention to the public policy of their companies. This involves a number of features, of which courtesy to customers on the part of all connected with the company is of paramount importance. The Public Service Commission of Indiana has during the past year organized its staff and work in a satisfactory manner. The personnel of the Commission is excellent and it is evident that it is trying to be fair-minded. Many very important utility problems are coming up before the Commission. Among these of particular importance at the present time are valuations and the question of what shall be regarded as a fair rate of return. The latter is a point that must be given most thoughtful consideration in order to conserve the vast investment in utility properties and to make possible future financing. Valuation of utilities is also a very complex problem and involves a number of features that need careful study. Speaking of activities of the Association, President English referred to its gratifying increase in membership and in influence. The financial standing of the organization has been vastly improved and this has permitted expansion of its activities into wider fields so as to increase its value to the membership in general.

The report of the Committee on Membership was presented by Thomas Donahue, Lafayette. This referred briefly to the method devised for an intensive membership campaign, which consisted in the appointment of one member in each of the 13 congressional districts of the state whose duty it was to be responsible for increasing the membership in that district. This plan has worked out very satisfactorily. On October 1, 1913, there were 66 active and 6 associate members; on September 22, 1914, there were 92 active and 26 associate members, an increase during the year of over 60 per cent.

Alex. R. Holliday, Indianapolis, then presented a paper entitled, "Rural Electrical Development in Indiana."

An extended abstract of this paper will be published in the next issue.

Accounting.

F. L. Dennis, as chairman of the Accounting Committee, then took over the meeting, which was converted into an accounting session. Mr. Dennis said that the Accounting Committee had sent out 500 letters to member companies suggesting that they submit to the committee questions that should be discussed at the convention; but very few definite replies had been received. He referred to the book by H. M. Edwards on "Electric Light Accounts," and urged that, as suggested by the author, there is need for active cooperation between public service commissions and utility companies in devising accounting systems that shall be complete and yet practical. Aside from standard classified accounts, it is necessary usually to include some special accounts required by local conditions. He discussed the accounting personnel and showed how important this department of a utility's organization is. The system of accounts adopted must be defined exactly in all its details in order that the data gathered thereby may mean the same thing for each utility.

A general discussion of a number of accounting matters was then opened by J. A. Browne, North Manchester, who thought that the subdivision of accounts

now required in Indiana is carried too far, at least for small plants. He thought that it should be simplified for the smaller utilities and its complications eliminated. E. J. Condon, Angola, urged active support and co-operation with the Accounting Committee of the Association. There is a great gap between the former "corner grocery" accounting methods and the system now required by the Commission. The smaller utilities particularly need to be taught the value of keeping accurate accounts and the method of doing so. W. E. Lowe, Connersville, thought it was impractical to put into effect by the small companies the Commission's elaborate accounting system. He has found it impossible to do this. T. Donahue said that the utility company in Lafayette is trying to follow out the Commission's system with a fair degree of success. He knew that the Commission had tried to develop its system of accounting on the advice of expert accountants. Therefore, if the system was faulty the Commission should not be criticised, but it should be informed as to the particulars in which the system should be improved or simplified.

F. A. Bryan, South Bend, opened the more detailed discussion on the proper handling of various accounts, requesting information on the division of construction accounts respecting rural lines in which both company and customers have participated in bearing the cost. F. W. Draeger, New York City, explained how the American Gas & Electric Company segregates these matters. J. W. Robb, Clinton, thought that it was desirable to have more classes of utilities provided for, so that companies of different size can find sets of accounts more suitable to their actual accounting needs than now seems to be the case.

F. L. Dennis said the Commission is anxious to receive definite suggestions on this matter, and others looking to the improvement of the classified system adopted. L. Fitzgerald, Gary, and Messrs. Gerst, Walling, George, Bryan and others discussed other topics, such as the keeping of accurate records of supplies. Mr. Bryan said that he is convinced that all utility companies would have to greatly increase the appropriations for their accounting departments.

E. J. Condon said that a company should not be afraid to charge off depreciation, and cited some instances in which failure to do this had caused embarrassment. This point was also emphasized by Mr. Bryan. W. B. Jackson, Chicago, said that the longer one studies the subject of depreciation the more uncertain appears to be the method that is best suited for handling it.

Going Value.

At the afternoon session the first paper presented was by Halford Erickson, member of the Wisconsin Railroad Commission. The title assigned Mr. Erickson's paper was "Valuation for Rate-Making Purposes." Since this subject is so vast, however, Mr. Erickson chose to limit his subject to only one feature of valuation for rate-making, namely, that commonly spoken of as going value.

This problem is a very difficult one, because it is intangible. The physical valuation is not a very troublesome matter because fair-minded appraisers and engineers can be found to agree quite closely on the tangible property of a utility. One of the most serious difficulties with regard to going value is that it has not been given proper and thorough thought. One can conceive of going value only by a common-sense consideration thereof. It may be defined as representing the reasonable cost of, or financial sacrifice yielded in, establishing the utility business. The physical plant without business is without particular value, since it represents so much dead matter. In order to make it a going concern requires much effort and cost. The cost of development of the business nearly always results in making the early years unprofitable ones. The reasonable losses incurred in developing the business should be reimbursed and constitute going value. It is almost universal for plants to show deficits in their early years. These might be avoided by establishing such high rates at the start as would insure payment of dividends immediately. This, however, is impractical. High rates would have to be almost prohibitive and would retard very decidedly the development of the business and would, therefore, defeat the object of the utility in giving as wide a service to the public as possible.

At a recent meeting of economists a speaker had taken up the subject of going value and criticised the attitude of the Wisconsin Railroad Commission respecting thereto. Mr. Erickson replied to many of these criticisms, most of which, he said, were based on misinformation. The theory of principal and agent which had been urged as leading to a more logical consideration of going value had not been followed out consistently in the argument, and if it had been carried out logically would have borne out the practice of the Wisconsin Commission instead of the assertions of the speaker in question. Mr. Erickson denied that the Commission's engineers are unduly favoring the utilities in making valuations; his statement is borne out by the fact that the Commission's valuations have been accepted both by courts and by municipalities.

Going into the subject of financing, Mr. Erickson pointed out the difficulties involved; discounts on the bond issues and other charges of bond houses must be allowed, because no other method of financing is usually available. Other necessary charges involved in the construction of the plant must be allowed. The conditions frequently vary and must be given due consideration in each individual case. The courts now realize that mere physical value is not the total value of a plant and that going value is one of the intangibles that must be taken into account. This is borne out both in purchase cases as well as in those involving rate questions. Mr. Erickson cited a number of cases in state and federal supreme courts bearing on this matter. An especially clear statement on this point has been made by the Oklahoma State Supreme Court. By charging the cost of developing the business as part of the valuation, this necessary item of expense is distributed among those who benefit thereby and this is, therefore, an equitable and lawful way of doing this, instead of making the early rates exorbitantly high to make dividends possible from the first. The going value should be considered as the deficiency in the early net earnings of the property from a fair rate of return and which has not been recovered or allowed for in the physical valuation. Mr. Erickson described the three common methods of allowing for going value and discussed their relative merits and equities. It should be borne in mind that plants are built not only for the present and immediate use but also for future customers, who should help bear the cost of the establishment of the service.

Problems Before Commissions.

Thomas C. Duncan, chairman of the Indiana Public Service Commission, then made an address covering a wide range of subjects, but dealing in general with the varied problems that come up before a utility commission. In opening his address, he expressed the gratitude of the Indiana Commission to the Wisconsin Railroad Commission and particularly to Mr. Erickson for the great courtesy and valuable aid given in helping establish the commission in Indiana. Valuation is a vital utliity subject of the day and of this going value is only one phase. Going value is such a difficult subject, not so much because of lack of agreement as to what general items that it should include, but on account of the difference of personal opinion as to just how much must be included in each item. Respecting this and other utility questions that come up before commissions, the courts must be the final arbitrators. Although they have passed on various features of the going-value question, they have not yet passed on it comprehensively as a complete issue. It is impossible to fix the going value of a utility without taking account of its complete history. If the utility has already had a fair return on the average (that is, say if it had at first had less and later more than a fair return) there is no further need of considering going value, since there is none to be taken into account. Therefore, in each case it is necessary to go over the records minutely. Commissions are not organized for driving utilities out of business, nor can they, on the other hand, permit them to loot the public. The rates established must be fair to both utility and public.

Commissions are frequently called upon to pass on other intangibles in the valuation, such as contingencies, etc. Reproduction new less depreciation is not a complete measure of the actual valuation. It is necessary to know the actual cost of building of the plant, the capitalization of the company, its earnings and other matters that bear on its complete history as a utility concern. Now, having all these actual data available it is possible to determine quite accurately the actual value by a fair-minded body. Judge Duncan was amazed that certain expert witnesses that had appeared before the Indiana Commission on behalf of some utilities had asserted that from 10 to 15 per cent is a fair return on the investment after allowing for all charges, contingencies, etc. It is evident that conservatism is needed on both sides and no absurd claims should be made. Commission regulation is the last experiment by the state to regulate utilities; if this fails, government ownership of utilities must follow.

After determining what is a fair rate of return a commission is called upon to decide on the division of the rates between private and municipal customers, between large and small customers, and other classes of consumers. By all means we should take care of the small customer to whom the expenditure of a dollar or so a month is quite an item. If this can equitably be done, the greatest measure of public service will be achieved. Other matters that must be passed upon, before the actual rates are determined, are on what are reasonably allowable operating charges and a great many other items that must be taken into account. Judge Duncan closed his address with some very frank remarks on the difficulties that the Commission has experienced, and said that it is going to do the best it can.

Lightning Protection.

A paper with the above title was presented by V. E. Goodwin, of the General Electric Company.

In opening this paper the protection of electrical apparatus was considered from the insurance standpoint. Lightning arresters should be selected that will provide the most effective protection to the system for a given investment. Theoretically, lightning arresters should prevent any abnormal rise in potential and at the same time alow no loss of power or disturbance in the system. This ideal is very difficult to attain in practice. Protective apparatus should be selected which will at all times keep abnormal potentials below the value where loss would occur. The paper makes a report on a large number of tests to determine the action of lightning on transformers. Several 2,300-volt lighting transformers were subjected to high-voltage, high-frequency disturbance and the voltage across various parts of the transformer measured by means of needle gaps to find the voltage stress on the insulation at those points. The method of test was very severe.

The tests illustrated very forcibly the value of placing an arrester near to the transformer; the actual stresses on the transformer were reduced to about one-sixth their former value by adding an arrester. In general, the inductance of a circuit does not permit any disturbance to travel along the line for any distance before the insulation at the point affected fails. Therefore, arresters should be installed directly at the terminals of the apparatus to be protected. The difference in protection by different types of arresters depends on their relative discharge rates. In the aluminum-cell arrester the only resistance to abnormal potentials is that of the electrolyte which, being low, makes this arrester the best possible type; multigap arresters require the addition of shunt or series resistance to aid the gaps in extinguishing the dynamic current; their discharge rate is therefore lower.

Answering a question by N. M. Argabrite, Mr. Goodwin said that the electrolytic arrester takes care of heavy line disturbances most effectively. W. E. Lowe asked about the method of making satisfactory pipe grounds. Mr. Goodwin said the best way was to drive a one-and-one-half-inch pipe from 8 to 10 feet into the ground so as to reach permanent moist earth. Then there is driven around this a two-inch pipe which is subsequently pulled up and the gap left around the smaller pipe is then filled with rock salt. The latter is caused to permeate itself around the ground through rain and serves to maintain a permanently damp and therefore good ground connection. The grounding wire is usually soldered to the pipe. Around a substation, where very heavy grounding is necessary, it is advisable to put as many groups of pipe grounds as the line conditions warrant.

W. D. Ray, Hammond, brought up the question of protecting insulators and lines of 33,000 to 66,000 volts. Mr. Goodwin said that the Nicholson arc-shielding ring had proved quite satisfactory, but doubtless the best way to protect the line itself was to install a ground wire over it. It is not customary to install lightning arresters all along a transmission line on account of the heavy expense involved, but at exposed points, such as where the line reaches an exceptionally high point, lightning arresters are desirable. For lines of 33,000 volts and over, the aluminum-cell arrester is the only one that gives reliable protection from internal surges.

Outdoor Substations.

A paper illustrated with many lantern slides was then presented by H. W. Young, president of the Delta-Star Electric Company, Chicago. The title of the paper was "Outdoor Substations and Weatherproof Equipment."

The ability to supply large, sparsely settled areas with adequate electric service depends largely on the possibility of installing outdoor substations of comparatively small size, in which the transformer capacity may be as low as 50 kilowatts. With such small loads it would be impossible, from an economic standpoint, to construct indoor-type substations and employ equipment considered necessary only a few years ago. The logical way of serving small communities and other scattered customers is, therefore, to employ high-tension transmission feeders tapped at various points by means of the modern low-cost outdoor substation. Whenever possible it is advisable on account of cost to use standard designs of such substation equipment, since these have been developed for practically every service. All steel and malleable iron parts of the equipment should be hot-galvanized since this affords the most reliable protection against rust. The transmission voltage of 33,000 is rapidly becoming standard for this class of service and equipment for this voltage is made in large quantities, is reasonable in cost and can be promptly delivered by the manufacturers. For most such installations the local distribution can be best accomplished by means of a three-phase delta-connected 2,200-volt system

The paper gave numerous tables and curves showing line costs of 33,000-volt transmission systems. Similar tables of the cost of outdoor subtation equipment for such lines were also given. In the case of very large transformers, these are mounted directly on the ground, but where the transformer capacity is 50 kilowatts or less the units are usually placed on a platform 10 or 12 feet above the ground. For this purpose provision must be made for readily raising and placing the transformers in position.

The protection of high-tension lines from short-circuits is a matter of much importance, since if the line is not quickly cleared serious trouble may follow. For use in connection with small-capacity substations the use of automatic oil circuit-breakers is practically prohibitive on account of high initial and installation cost. The development of a chemical fuse for high-tension work has been found to solve the problem very easily. Such fuses have been found, as the result of repeated and exhaustive laboratory and service tests, to clear the circuit as quickly, or even quicker than expensive oil circuit-breakers. Oscillograph records were shown to verify these statements. Another thing that has made the outdoor substation practical is the successful development of air-break pole-type switches. At first it was feared that these could be used for disconnecting purposes only, but it has been found that they can be opened under load conditions quite satisfactorily. These switches have been developed also so that heavy sleet does not cause them to be frozen in a manner that prevents operation. As lightning equipment and as an auxiliary arc-rupturing device in connection with the switch, horn gaps are used. In many cases choke coils are also employed.

Such outdoor equipment, while it does not insure absolute continuity of service, does provide in a very satisfactory way for reasonable continuity. An occasional interruption of service to an isolated group of rural consumers should not be a criticism of this serv-

ice. A general interruption of the entire line, however, would be very serious. Therefore, equipment that localizes the disturbance is all that is needed.

Mr. Young showed illustrations of a very large number of outdoor substations of various sizes and of many designs from the very simplest to others employing steel towers with more or less intricate protective equipment. These have been found to give good service.

After the presentation of the paper, the question of the effect of air-break switching was discussed and Mr. Young stated that contrary to original expectations it has been found that this type of switch does not cause appreciable line disturbance. The reason for this was explained by N. M. Argabrite as being due to the increasing resistance introduced in the circuit by the arc rising on the horn gap.

Street-Lighting Fixtures.

On Thursday morning the session opened with the presentation of a paper by W. P. Hurley, of the Westinghouse Electric & Manufacturing Company, entitled "Street-Lighting Fixtures and Regulating Equipment for Type C Mazda Lamps."

The paper opened with a description of the new type of lamp for street-lighting service. These lamps have been found especially applicable to three or more distinct classes of street-lighting service. For thinly inhabited outlying districts they will probably supersede all other forms of lighting, on account of low operating and initial costs. Lamps of 100 candlepower, quite widely spaced to serve as path indicators are usually employed for this purpose. The fixtures are usually of the bracket or center-suspension type with radial or fluted reflectors. For residence streets lamps of 250 candlepower or larger should be employed. A lamp of the size mentioned is practically equal in illuminating power to the 6.6-ampere alternating-current series inclosed arc lamp. If such lamps are installed at the corners, then it is well to place intermediate lamps of small candlepower at least half way between.

For the more important streets, such as have heavy traffic, lamps of 600 to 1,000 horsepower are needed. These have been developed in the gas-filled type and usually are made for operating with 20 amperes in the lamp circuit. Since this current value would be prohibitive as a line current and in order to adapt the lamps to the station equipment now commonly used, the 20-ampere lamps are usually provided with an individual auto-transformer or compensator which can be arranged with taps to be used on either 6.6 or 7.5 amperes or other line current. The compensator is installed at the top of the fixture and a multiple socket is connected in shunt to it. The compensator must have a very rugged winding not only to withstand line surges, grounds, etc., but also on account of the high heat developed in the lamp. For this purpose special insulation is used. The fixtures must be thoroughly ventilated and screened openings should be provided as a protection against the entrance of insects. The fixture must have such a general form as to protect the lamp itself from rain or snow, since the high temperature of the bulb would cause it to crack if suddenly chilled. Diffusing equipment must be provided, for the larger lamps at least, and in many cases reflectors and refractors are also included. The new type of lamp readily adapts itself for the lighting of boulevards and business streets with ornamental equipment, but should preferably be used on series circuits in order to secure the higher efficiency of the heavy-current lamps.

A large part of the paper was given to a description and discussion of relative advantages of different regulating systems for series street lighting.

Controlled Flat-Rate Residence Service.

A. T. Holbrook, of the Excess Indicator Company, Pittsburgh, then presented a paper entitled "Profitable Methods of Obtaining Old-House Lighting Business." In opening this paper he pointed out the relative lack of development of residence business in most cities east of the Mississippi River, and contrasted this condition with the marked development that has been achieved in small-house lighting in Europe. The flat-rate system solves the problem with the very small customer. It is usual when employing this system to install only tungsten lamps. The customary rate is $1.00 a month for each 100 watts of maximum rated load. The customer can install as many lamps as he wishes to make up the 100 watts or more that are contracted for and a little over this. To guard against the use of more than the contracted current, a current-limiting device or excess indicator is introduced. As soon as the current taken exceeds the allowed maximum the indicator interrupts the circuit periodically, causing the lights to wink until the number of lights is reduced to within the allowable maximum.

In order to introduce this system satisfactorily it is necessary to arrange for low-cost wiring of the premises. It is, therefore, advisable to arrange with contractors or wiremen to undertake the work on a definite cost basis per outlet. Mr. Holbrook explained in detail the methods used in Muncie, Hartford City and other Indiana towns, where the introduction of the flat rate with excess indicator has brought about a great extension of service among residence customers. After using the service on this basis many of the customers subsequently change to the meter basis in order to get the use of flatirons and other electrical appliances. Mr. Holbrook cited figures showing the marked increase in residence business in many Indiana cities and in other places, which was made possible by the use of the excess indicator and flat-rate system. Customers on this system furnish a satisfactory load and the net revenue per kilowatt-hour is almost exactly the same as in the case of meter customers.

The controlled flat-rate system is in use in about 200 towns in the United States, and the results shown by these installations indicate an increase of 50 to 100 per cent in residence load. Detailed results were given of the experience in Hartford, Conn., Scranton, Harrisburg and Pittsburgh, Pa., and in other cities. The business developed is from the poor people, miners, mill hands, negroes, etc. The extension of electric service to this class of customer has proved not only profitable to the electric companies supplying it, but has been very valuable among people who should be given modern conveniences at reasonable cost.

In answer to a question by J. A. Browne, North Manchester, Mr. Holbrook explained the manner of effecting current control by means of the indicator. The design permits regulating the amount of maximum current to be allowed. Any excess is interrupted in the manner previously described. The instrument is sealed and cannot be tampered with. The usual rate is one cent per watt per month. The usual minimum is $1.00 per month; the maximum runs up to about $1.75 per month. The cost of the controller is $7.50 to $4.50, depending on the number of instruments sold. From the large number of central stations employing these instruments, no cost of maintenance of the equipment is reported aside from periodical inspection of the installation.

Replying to a query by T. Donahue, Mr. Holbrook said that the comparative return from customers on the meter basis has been found to be $1.27 against $1.37 on the flat-rate system in Superior, Wis. Similar returns had been obtained in other places.

T. F. English, Muncie, said that in that city about 21 per cent of customers on the flat-rate system subsequently changed to the meter service. Changing from the meter to the flat-rate basis has been very seldom done. The system has been used for reaching small residences only, some of them merely shacks. The maximum demand contracted for is taken as 75 per cent of the connected load, which, in the case of Muncie, is entirely in 25-watt tungsten lamps. Little trouble has been experienced with collections. A penalty of 25 cents per dollar is imposed for failure to pay promptly. Further details of the schedule and method of furnishing flat-rate customers in Muncie were also given by Mr. Thurman. It is optional with the customer as to whether open or concealed wiring will be installed. The revenue per kilowatt-hour is about nine cents from the flat-rate customers.

E. J. Condon, Angola, asked how much it costs to serve a small customer

on the flat-rate basis. He cited some figures given in a report by Alex Dow, of Detroit, on the cost of serving a customer on the meter basis. Mr. Holbrook stated that in the case of flat-rate customers it costs about $4.50 total per 100 watts to an income of $12.00 per year against a total cost of $7.00 per $12.00 on the meter basis.

N. M. Argabrite, Muncie, said that he had found that small customers furnish a very valuable load, inasmuch as they help pay their share of the overhead costs of the plant. The main feature of the problem of making flat rates pay is to secure a saturated residence load. It would not pay to put up a line for merely one customer here and there on the flat-rate system; on the other hand, where practically all the residences in a block are connected to the line a flat-rate system is very satisfactory. In any case it is necessary to go after the business actively. Some few years ago when the flat-rate scheme was first suggested to him he was very dubious about its value. Since it has been installed and he has had a chance to observe its results he came to appreciate its value. It serves to introduce electricity to the very small customers and after a few years brings about their change to the meter system so that they may use irons and other appliances. In order to introduce electricity to the very poor, electric lighting must be the first service. The flat-rate scheme is definite and simple and permits the customer to know exactly what must be set aside each month.

T. Donahue, Lafayette, stated that his experience had been that the flat-rate customers tend to abuse their privilege of using current. For instance, it will be found that the porch light will be allowed to burn all night and sometimes light will be left burning even all day. Mr. Holbrook replied by reading the figures reported from various plants, showing that the average consumption of flat-rate customers is from three to four hours per day of their allowed maximum. Reports from some 200 plants do not show any abuse on the flat-rate system when controlled with a current-limiting device.

E. J. Condon said he had found the flat-rate system to serve its purpose admirably in the introduction of the service to the very small customers. With these it is necessary to relieve the prejudice against the meter. However, this can also be done by teaching the customer how to read the meter. Then he will realize that he is not being cheated and can keep tab on his consumption. It should be remembered, also, that it is necessary to go after more than the lighting load and this can be done by developing the liberal use of electrical appliances only on the meter basis.

T. F. Grover, Terre Haute, stated that any system that will get customers is good. One of the chief difficulties in getting customers in small residences is to get reasonable-cost wiring; contractors should be encouraged to undertake this work at reasonable prices. If this can be done, it will be found that customers will be as ready to use the meter system as the flat-rate system.

Mr. Holbrook concluded the discussion by stating that it is impracticable in this country to go below a $1.00 minimum per month. In Europe the minimum charge in some places is as low as 20 cents and others 40 cents. In Hartford City, Ind., 95 per cent of residences are wired, because they have been wired on the contract per outlet basis.

Accounting Club.

The afternoon session opened with a report of the Accounting Committee, submitted by F. L. Dennis, South Bend, chairman. The committee recommended that a very good plan in order to get accountants of the utility companies to discuss their problems would be to form an accounting club to consist of the chief accountants of all member companies and to meet once every three months or oftener to discuss their problems intimately. Such a plan has worked out very well in New Jersey. It would be well to meet in different cities of the state, particularly in those places where good accounting systems had been put into effect and where the books of the company can be thrown open to the accountants so that the system may be studied in detail.

C. M. Poor, Clinton, commended the plan heartily and thought that accountants of municipal plants might even be included to advantage. President English stated that the latter suggestion was unconstitutional, because municipal plants are not admitted to membership in the Association. E. J. Condon, Angola, also strongly endorsed the plan. If municipal plants will have accurate and scientific accounting put into effect the fallacy of municipal ownership will be quickly exposed.

T. Donahue urged that the managers of member companies send their accountants to the proposed club meetings. J. A. Browne said he was convinced that much good would result from the plan and urged that provision be made in the meetings for the comfort of the many lady accountants employed by Indiana companies.

The New Mazda Lamps.

J. R. Colville, of the equipment department, National Lamp Works of General Electric Company, then presented a paper entitled "The Newer Mazda Lamps and Some of their Applications."

This paper first reviewed the history of incandescent-lamp manufacture and showed the very marked increase in efficiency between 1879 and the present year. Mr. Colville described the construction and characteristics of the new gas-filled tungsten lamps and discussed their need for ventilation. He showed that the lamps give off no more heat than is the case with other lamps of similar wattage.

Among the uses that are being developed for the new lamps are application to photography, which heretofore has been practically impossible with incandescent lamps. Gas-filled stereopticon lamps are being used for a variety of purposes. The new lamps are being used in projectors for flood-lighting of exteriors.

In street lighting central stations are realizing the advantages of the new lamps to the greatest extent. In existing tungsten-lamp installations old lamps may be replaced with the new and increased efficiency obtained or increased lighting secured at the same cost. The new lamps approximate a point source and therefore in connection with reflectors they give much better results than any filament lamps heretofore. The prismatic refractor especially developed for street lighting was described. The new lamps have taken away the last excuse for using alternating-current inclosed arc lamps. Their increased power-factor permits loading up of the circuits with new lamps to a greater extent than is possible with arcs, and therefore extensions can be made without increasing the station capacity. The illumination from the new high-power Mazda refractor units results in two to three times the useful light obtainable for a similar number of 6.6-ampere inclosed arcs.

In the way of multiple lamps the sizes available have been increased so that lamps from 200 watts upward can now be obtained, and these are coming into use for store lighting and for the illumination of many industrial establishments and other places where a relatively high-power unit is serviceable.

Replying to a question by President English, Mr. Colville showed that the cost of station equipment for a 400-candlepower gas-filled lamp as compared with a 6.6-ampere alternating-current inclosed arc is but one-half, because only one-half of the kilovolt-amperes are required due to the greatly improved power-factor and illumination efficiency. The fixed charges are, therefore, very decidedly reduced, and this greatly offsets a slightly higher maintenance cost with the new lights. The average useful life of the new series gas-filled lamps for street lighting has been found to be close to 1,350 hours. The paper was discussed further by Messrs. Browne, Thurman, Palmer, Hurley and Colville.

Public Policy of Utilities.

D. L. Gaskill, secretary of the Ohio Electric Light Association, then made an address on the subject, "Public Policy of Utilities." He contrasted the practice in this regard of utility companies 10 years ago with the status of the matter in recent years. Now this has become a very live subject and commands much attention upon the part of utility managers. The public interest in a

utility is confined to two features—service and rates. If the former is made the best possible and if the second is reasonable, the problem of satisfactory public relations has been solved.

An electric utility is a natural monopoly. Therefore, it requires much more tact in the conduct of its business than in that of an ordinary competitive business, such as merchandising. In the latter, if the customer is not satisfied he patronizes a competitor. It is very imperative that utility companies should overcome the tendency toward public suspicion of their acts, and they must strive by every effort to have satisfied customers. It is very uncommon now to find unreasonable rates. Commission regulation, as well as the competition of other illluminants and sources of power, has eliminated exorbitant rates. Moreover, it has been found that wherever rates have been lowered the increased business obtained makes up for the revenue. Therefore, the problem simplifies itself to giving the closest possible attention to the service. This means not only as regards its engineering requirements, such as voltage regulation, maintenance of continuity, etc., but much more important, courteous and prompt attention to the customers.

Many utility companies have altogether too many rules which hamper customers and create ill will. A utility company should have but two rules, one as to when bills should be paid and the other as to the minimum charge. The more rules there are the more infractions thereof will be met with and, therefore, the more enemies incurred. Arduous rules are particularly erroneous and really fatal to the development of good will toward the utility. The assertion that lack of rules leads to discrimination is not necessarily true. Fair, open dealing with all customers is very much better than the exaction of a lot of rules that are but partly enforced and therefore much more discriminatory.

One of the most difficult features of public policy is the matter of municipal relations. This comes up probably most often in connection with street lighting contracts. A modern and sensible basis for such contracts is to assume them on a cost basis, plus a fair profit. The contract having been entered it is necessary to give as good street-lighting service as any other service. This means prompt attention to outages, cleaning of globes and equipment, painting of posts, etc.

The proper handling of complaints is a matter of vital importance. While many complaints are erroneously made, they frequently are, however, blessings in disguise. Complaints must always be received courteously and must be given immediate attention. Usually they are of trivial character and can be quickly and permanently attended to.

Mr. Gaskill urged an extension of service by giving what he called individual service to customers through frequent visits to their installations not only for inspection, but in order to make suggestions by which they can secure better and more light, and also the use of many electrical conveniences. Such visits might well be made as frequently as once a month, and if made in the proper manner so that the customer realizes that the utility is trying to maintain and give the best possible service and to improve it, the friendship of the customer will be developed. Especially is it important to see that lighting equipment is well maintained.

Publicity is urgently needed. This must be not only in the way of advertising of increased electrical facilities by means of which the central station can secure increased load, but educational efforts to instruct the public on the many difficulties attending the utility business, such as the actual cost of giving the service and the many elements involved in that cost. Relatively little work has been done along this line. The railroads have recently been waking up to the need for taking the public into their confidence. Now, on account of the municipal ownership agitation in many parts of the country, it is imperative to take up a strong educational campaign to expose the fallacies of this theory, the inefficiency of municipal operation, how taxpayers are defrauded by poor accounting methods, etc. Such an educational campaign need be no more expensive than a campaign to increase the load and its ultimate results would probably be very much more valuable.

Mr. Gaskill's address was discussed by F. A. Bryan, T. F. English and T. Donahue. President English said that the Muncie company has two ladies call on residence customers to suggest improvement in illumination. This work has in six weeks resulted in greatly increased lamp sales. Many old carbon lamps were found to be in use, especially in premises where the bills had been high. Mr. Donahue said a similar scheme was successfully used in Lafayette.

Standardization.

W. C. Culver, Cincinnati, O., brought up the subject of standardization of lamp voltages and the advantages resulting therefrom. The Ohio Electric Light Association has appointed a committee on the subject. Tungsten lamps can be made very much closer to rated voltage than carbon lamps; therefore the need for various line voltages has diminished. A standard voltage would permit economy in manufacture and reduction in cost. Mr. Culver suggested consideration of the subject by a committee of the association.

F. A. Vaughn, Milwaukee, Wis., spoke of the value of co-operative work by meter committees of different electrical organizations. The Wisconsin Railroad Commission has gladly received suggestions from the meter committees of the Wisconsin Electrical Association and the National Electric Light Association. These suggestions have been of value especially in the drafting of the Commission's rules as to meter accuracy, tests, etc. Since the Indiana Commission has not yet passed on these matters, a committee should be appointed to prepare suggestions along this line; the National Electric Light Association's committee will cooperate in this work.

On motion of E. J. Condon, Angola, it was decided to appoint a committee on standards to consist of five members. This body will take up the subjects brought up by Messrs. Culver and Vaughn and other matters in which standardization is desirable.

J. W. Robb, Clinton, chairman of the Executive Committee, submitted its report, which showed that the increased dues of the Association, its larger membership, and advertising in its souvenir program have put it into excellent financial condition. This increased strength has made the Association a live organization with greater influence. The report of the Finance Committee showed that the Association has increased its assets by about $2,200 during the year. The detailed reports of the treasurer and secretary were presented and accepted.

The Committee on Constitutional Revision reported through F. A. Bryan the topics recommended for amendment. Among these were a more clear definition of active membership, enlargement of associate membership to include contractors and supply men, increase in dues, etc. These are to be submitted by a letter ballot to the membership.

Election of Officers.

The Nominating Committee submitted a set of nominations for officers of the Association for the ensuing year. These were elected as follows:

President, T. F. Grover, Terre Haute.
Vice-president, E. J. Condon, Angola.
Secretary, T. Donahue, Lafayette.
Treasurer, F. L. Dennis, South Bend.
Executive Committee, T. F. English, Muncie, chairman; C. C. Perry, Indianapolis; Alex. R. Holliday, Indianapolis; S. W. Greenland, Fort Wayne; E. Holcomb, Francisville.
Advisory Committee, T. C. McReynolds, Kokomo, chairman; F. A. Bryan, South Bend; W. D. Ray, Hammond.

Illuminating Engineering Society.

Eighth Annual Convention, Cleveland, September 21-24.

The eighth annual convention of the Illuminating Engineering Society was held in Cleveland, O., September 21 to 24, with headquarters at the Hotel Hollenden, where the sessions were held.

The convention was a success in every way. The registration was close to 300.

The opening session was called to order on Monday at 11 a. m., by W. M. Skiff, chairman of the General Convention Committee. Mayor Newton D. Baker was present and made a very impressive address of welcome to the city. This was responded to upon behalf of the Society by Prof. G. A. Hoadley.

President Bond then called Vice-president George H. Stickney to occupy the chair while he presented the presidential address. Among other things brought out in this address was the need for establishing criteria of good illumination so that the proper illumination under specific conditions might be standardized. The time should be ripe to do this now if we have the necessary courage. He mentioned that a committee had been appointed to determine upon the proper illumination of the Society's Council room in New York City and this should be a model of correct artificial illumination. He referred to the futility of trying to convert persons whose habits are already fixed to new methods of doing things. With children, however, it is different and propaganda work should be directed especially to them, primers on good illumination being placed in the hands of every teacher. While much good work that might be done by the Society depends upon the availability of funds for the purpose, he thought that if these funds were wisely used they could be replenished by sustaining memberships of municipalities, individuals, etc. Among other things he mentioned that a new illuminating engineering society is about to be formed in Japan.

Mr. Stickney appointed as a committee to consider the presidential address: C. H. Sharp, J. R. Cravath and G. S. Barrows.

The report of the Committee on Progress was then presented by F. E. Cady. This report summarized the developments in the field of illumination and related subjects during the past year.

The report of the Committee on Research was presented by Herbert E. Ives. This report told of the aims of the committee, the meetings which have been held and the methods pursued in its work.

The afternoon session was opened with a paper by L. A. Jones entitled "The Color of Illuminants." In the absence of the author this was presented by H. P. Gage.

The Color of Illuminants.

Color determinations in terms of dominant hue and percentage of white have been made on a number of sources according to the monochromatic method of analysis, which eliminates the use of any arbitrary reference standard. The principle involved is that any color can be matched by the mixture in the proper proportions of white light with monochromatic light of the required wave-length. Values are given for 14 types of illuminants and in addition there are curves and tables showing the variation in Nernst, tungsten, carbon and nitrogen-filled tungsten lamps operated through a wide range of efficiencies. Data are given for rapidly standardizing these lamps by color with a colorimeter.

The discussion was opened by W. R. Mott, of Cleveland, who said that sunlight is not as good a standard as skylight for color matching. It makes the incandescent lamps appear whiter than they really are. He referred to the results of Block, which had been published last year. So-called white flaming arcs vary among themselves in color. Pearl white is preferable for some purposes, but for others, such as illuminating jewelry and fish markets, a snow white is preferable. Figures were given for flaming arcs.

Herbert E. Ives compared the method of the author to that of measuring three colors. The method used by the authors had been proposed years ago by Abady and he had used it himself. It has the advantage of lessening the personal equation, but it requires a standard of white light and means of comparing the intensity of colored light with this standard. Arbitrarily standards of white light can be readily set up and the problem of heterochromatic photometry is nearly solved, so that there is no advantage in substituting a method which proposes something undetermined.

W. C. Moore said that the crater of the arc is the whitest source available and gave figures to show this.

M. Luckiesh favored the method of the authors to the three-color method. He considered both methods weak because they lead to wrong conclusions. The figures given by the author do not agree with those obtained from a spectral-energy curve.

J. B. Taylor and C. H. Sharp also joined in the discussion. In closing, Dr. Gage stated that the Corning Glass Works is using this instrument to settle problems with signal glass and he thought it would prove a good method. A reproducible standard of daylight is necessary for the instrument.

M. Luckiesh then presented a paper by F. E. Cady and himself entitled "Artificial Daylight, Its Production and Use."

Artificial Daylight.

The paper first deals with the general problem of producing artificial daylight. The color values of the old and new tungsten lamps are given and these illuminants are compared spectrophotometrically with two phases of daylight, namely blue skylight and clean noon sunlight. Ideal color screens for producing these two phases of daylight from the vacuum and gas-filled tungsten lamps have been computed. From these the daylight efficiencies of the lamps have been obtained. The theory and practice of the additive and subtractive methods of producing artificial daylight are described. The method of developing a color screen for producing daylight for use with tungsten lamps is presented and this is accompanied with the practical results that have been obtained. A general discussion of other means of imitating daylight and a bibliography of the subject are given.

This paper was discussed by R. F. Pierce, E. B. Rowe, H. P. Gage, M. G. Lloyd, G. H. Stickney, D. M. Moore. Mr. Gage stated that he had been working along the same lines and had made a screen for a carbon-filament lamp which gave the sensation of white. The same had been done with a gas-filled lamp, but discrepancies from daylight were found when it was used with dyed materials. He exhibited curves showing the results found and comparing his screen with those of Mr. Luckiesh and Mr. Brady. He found that more accurate correspondence to daylight could be secured by the use of three separate glasses. The authors had made a better approximation to skylight than to daylight. It is easier, however, to manufacture a single piece and if it is sufficiently approximate it is, of course, preferable.

Mr. Stickney referred to the different uses of artificial daylight and pointed out that the accuracy of reproducing it need not be so great for stores as for dye establishments, etc. Heretofore a northern sky has been used because it seems to vary less than other standards. There is, however, no reason why a standard artificial light should not be yellower than this and if reproductability could be assured, the dyers might be willing to abandon their preference for a light containing more blue. The matching of mineral and aniline dyes presents one of the greatest difficulties.

Mr. Moore claimed that a carbon-di-

oxide tube approximated daylight better than any method of absorbing screens.

In closing, Mr. Luckiesh pointed out that Dr. Gage had used a different standard from the authors for white light, namely, a black body at 5,000 degrees instead of 6,000 degrees centigrade. He pointed out some of the uses of artificial daylight in addition to matching colors, such as in lithographing establishments.

Edward J. Brady then presented a paper entitled "The Development of Daylight Glass." This recounted the work done in experimenting with many different coloring materials for glass and the endeavor to select one which when used with a Welsbach mantle, would transmit light equivalent to a black body at 5,000 degrees centigrade, which is considered equivalent in color to a white surface illuminated directly by the sun at midday. The result was finally attained by using a potash-barium glass. The method of producing this and obtaining it in the desired thickness was described. Curves were given showing the spectral distribution of the lamps, the various glasses tried and the perfected daylight.

The paper was discussed by E. B. Rowe, H. E. Ives, M. Luckiesh, J. B. Taylor, G. A. Hoadley, F. E. Cady, G. H. Stickney, H. P. Gage, C. O. Bond, J. R. Cravath, Ward Harrison, J. P. Hanlan and Norman Macbeth. Mr. Rowe suggested that the Research Committee should determine upon a standard daylight. He referred also to the importance of permanency in the correcting glass used. Professor Hoadley thought such a glass should find application in the home. Mr. Stickney emphasized that diffusion of light as well as its intensity and color is important in color matching. The greatest accuracy in matching is required in textile mills, where small areas must sometimes be illuminated up to 30 foot-candles; for other work larger areas need to be illuminated only to lower intensities. In stores six foot-candles are usually sufficient. Mr. Macbeth thought that the light should be standardized not by the Society but by some Government authority, such as the Bureau of Standards. He referred to the difficulties in matching and harmonizing differently colored fabrics under both daylight and artificial light. He pointed out that for such purposes as an evening suit, a blue cloth gives a richer black than a black cloth.

At the session on Tuesday morning the first paper presented was by A. S. Osborn on "Relation of Light to the Critical Inspection of Documents." This was accompanied by lantern slides illustrating instances where changes in documents could be detected by scrutiny under proper circumstances. The general need of correct illumination in court rooms was emphasized. The dispensation of justice is often influenced by proper conditions of illumination.

This paper was discussed by F. E. Cady, R. T. Ely, John B. Taylor, H. E. Ives and L. B. Marks. Mr. Taylor suggested that photographs which are to be used as evidence should be made upon the stereoscope principle and should be color photographs. Mr. Osborn replied that the stereoscope camera has been used but that such evidence would not be admitted in many courts. He knew of only one case where it had been admitted. It was undoubtedly valuable to bring out the third dimension and relief can often be exaggerated by proper manipulation so as to disclose things which the unaided eye could not detect.

The next paper, entitled "Planning for Daylight and Sunlight in Buildings," by L. B. Marks and J. E. Woodwell, was presented by Mr. Marks.

Planning for Daylight in Buildings.

The broad problems that come up in planning for daylight and sunlight in buildings are considered and the state of the art of daylight planning is reviewed. Emphasis is laid on the hygienic and pathogenic value of daylight and sunlight in rooms, and on city planning for good daylighting. The factors that enter into the solution of the problem of providing for adequate and suitable daylighting facilities are discussed and formulas are given for the calculation of daylight illumination in buildings. By the simple expedient of a wire frame (representing the solar path) mounted on a small cardboard model of a building made to scale, the penetration of sunlight and obscuration by shadows are quickly predetermined in actual cases. A new instrument for sunlight and shadow determinations is described and illustrated. Daylight illumination measurements in a test room and in several court rooms of the County Court House, New York, are given. The application of the principles involved is illustrated by a discussion of the daylighting facilities of the New York Court House, accompanied by data, charts and plans of the building and court rooms. A bibliography is appended.

This paper was discussed by S. G. Hibben, G. H. Stickney, A. J. Sweet, W. A. Durgin, H. E. Ives, J. R. Cravath, J. B. Taylor, Norman Macbeth, A. S. Osborn, M. G. Lloyd, F. A. Vaughn and Mr. McCormack, a Cleveland architect. Mr. Hibben suggested the use of prismatic glassware to redirect the light under porches, which often make the front rooms of residences very dark; and the use of translucent bricks. Mr. Stickney pointed out that both illuminating engineers and architects have not given enough consideration to securing daylight illumination. Dr. Ives spoke of the importance of the brightness of objects in the field of view and said that it was generally disagreeable to face windows having a sky exposure. Illuminometer readings are often no criterion of the suitability of the illumination; it gives rather the suitability of the light for blueprinting, whereas the suitability as measured by an observer's comfort was comparable rather to the suitability for taking a photograph. Mr. Cravath pointed out the enormous variations in the intensity of daylight from day to day and from hour to hour, especially in cities. This may vary from 2.5 to 100 foot-candles. Mr. Taylor agreed with Dr. Ives, and pointed out that city buildings are usually compromises and all of the rooms cannot be ideally arranged and illuminated.

Mr. Macbeth said that artificial lighting is often preferable to daylight lighting, as actually arranged. Moreever, its cost may be as small as two per cent of the rental of the premises, as in the case of a certain New York store, and this cost is consequently immaterial as compared with the securing of proper illumination. Mr. Osborn pointed out that the architects have arranged the windows for appearance rather than efficiency. Dr. Lloyd told of a case where good daylight illumination had been secured without the objections referred to by Dr. Ives. Mr. McCormack, who had worked on the plans for the New York Court House and is now engaged in designing schools in Cleveland, pointed out that both appearance and utility are being considered in the latter work. The compromises necessary in city buildings account for the restrictions often observed and it is impossible to make such buildings ideal.

In closing, Mr. Marks pointed out that, due to the uncertainty as to what buildings may be erected in the neighborhood, elasticity must be provided in arranging for the daylight illumination. This is one reason for avoiding unilateral lighting.

C. H. Sharp then presented a paper entitled "Air-Shaft Illumination as Studied by Models." This paper described experiments carried out by constructing models with typical proportions to correspond to the air shafts of tall buildings and measuring the light received by windows at different distances from the top and with different conditions of the surface of the shaft. A number of curves were given showing the intensity of illumination received at these points for both square and oblong shafts. He concluded that a glossy white surface was to be preferred, at least for deep shafts, and that there is a great gain in illumination due to using color of high reflecting power.

This paper was discussed by A. S. McAllister and L. B. Marks. Dr. McAllister indicated how the illumination intensities to be expected could be

worked out mathematically. He had done this and found the values to check with the experimental values given by the author.

A session was held on Tuesday evening, which was of a more popular nature and was attended by a large number of ladies and other nonmembers. John Hammond Smith presented a paper entitled "Photo-Sculpture and the Use of Light in the Production and Illumination of Sculpture." By taking the photographs of a subject from two different positions and projecting the images from the developed negatives in the same positions, the outlines of the subject could be accurately reproduced. This principle has been modified in a way to make it practically applicable. If, after a sculpture has been completed a photograph of the subject is projected upon it, a very lifelike impression is produced.

The second address was by M. C. Rypinski upon the subject of "Color Photography." This outlined the history of the development of this subject and included a large number of lantern slides illustrating the methods employed and showing the results obtained, especially by the autochrome and Paget processes. This was supplemented by a number of lantern slides taken by different methods by John B. Taylor.

On Wednesday parallel sessions were held both morning and afternoon, President Bond presiding at the laboratory sessions and Vice-President Cravath at the commercial sessions.

Commercial Sessions.

The first paper presented at the morning commercial session was by J. L. Minick and was entitled "The Locomotive Headlight."

The Locomotive Headlight.

A number of states have recently passed laws specifying the light requirements for locomotive headlights, almost all of which virtually exclude all classes of light sources except the electric arc light. Apparently little thought was given, in the framing of these laws, to the possible damage accompanying the use of high intensities in the light beam. A number of tests have been conducted from time to time to determine the dangerous conditions that may arise from the use of various classes of light sources in headlight service. These test data, so far as they are available, have been collected, compared and analyzed, and such points as have been well established are presented in this paper in terms as nearly comparable as possible. Formulas have been developed and are presented wherever the data available seem to warrant doing so, and conclusions are arrived at by the use of methods differing from those employed in various test reports. The results show that the conclusions and recommendations of the American Railway Master Mechanics' Association are entirely correct if carried out within the limits given in this paper.

W. R. Mott, of Cleveland, declared that the inverse-square law holds approximately correct for headlights and searchlights.

A. L. Powell read a communication by L. C. Porter, in which the difficulty of defining the edges of the beam in the case of large sources of great spread was emphasized. Locomotive numbers are best placed at angles of 30 degrees, just behind the lens, so that they can be read from both the front and sides. With an incandescent lamp source, a beam intensity of 900,000 candlepower can be obtained, enabling a dark object to be seen at 1,200 feet, and a medium-colored object at 1,600 feet.

J. R. Cravath cited the need for more definite specifications for the measurement of headlight candlepower.

G. H. Stickney emphasized the greater accuracy of curvature of glass reflectors, and said that the inverse-square law holds for distances beyond which the light becomes homogeneous.

In closing the discussion, Mr. Minick remarked that all the measurements were made at a uniform distance of 25 feet, a convenient distance when tests are to be made inside buildings.

The next paper, by A. L. Powell and R. E. Harrington, was entitled "Present Practice in the Use of Tungsten-Filament Lamps for the Lighting of Metal-Working Plants."

Lighting of Metal-Working Plants.

This paper gives the results of an investigation of the lighting of various metal-working plants. A discussion of the different methods of direct lighting commonly employed and the types of metal reflectors most generally applicable is followed by a consideration of the processes found between the ore and the finished product. The following data on the different operations is compiled: class of work, size of lamp, style of reflector, spacing of lamps, type of illumination, hanging height and watts per square foot. As this information is taken from plants that are satisfactorily lighted from the standpoint of the management and workmen, it should be of value as a guide to the designer and of considerable use to the practical engineer and commercial man.

H. T. Spaulding pointed out that the correct intensity of illumination is of great importance in industrial installations.

Robert Ely said that it is often difficult to convince owners that the expense of a high general illumination for shops is advisable in preference to an arrangement of low-intensity general lighting with special illumination at each tool. He recommended the adoption of standard lamp locations for printing presses, machine-tools, etc.

R. P. Burrows said that such standardization of machine lighting would be very difficult, since each operator has his own views as to where he wants his lamp placed.

R. E. Simpson said that other lighting should be provided in foundries than that from the molten metal itself. Insurance statistics show that 60 per cent of all accidents occur at night by artificial light.

C. A. Littlefield pointed out that factory illumination affords a chance for the closest co-operation between the lighting and motor-service departments of the central station.

J. P. Mallett urged that lighting problems be referred whenever possible to professional consulting illuminating engineers.

The final paper at this session was one by O. R. Hogue and A. O. Dicker, entitled "Factory Lighting." It was presented by Mr. Dicker.

Factory Lighting.

This paper contains data derived from 25 factories where installations of factory lighting units have been made by the Commonwealth Edison Company, Chicago, under a special contract providing separate charges for rental of equipment, maintenance, and electric energy. The form of contract is given. The rental charge is 25 cents per month per lighting unit, and continues for two years, at the end of which the equipment becomes the property of the customer. The maintenance charge is 25 cents per month per unit except during the three summer months, and covers cleaning every 10 days and renewal of burned-out lamps. Customary rates are charged for electric energy. The lighting unit and its distribution curve are illustrated and installation maintenance and cost data are given for the 25 factories. Illumination tests have not been made, but the values may readily be computed.

In opening the discussion, George H. Stickney said that industrial lighting is a field overlooked by many central stations.

Harold Calvert questioned whether it is advisable for the central station to assume the investment of installation expense, without offering the same accommodation to all its customers.

W. J. Ayrston described the system of inspection and renewals followed in the Westinghouse shops at East Pittsburgh. Of the 12,000 lamps in use, 4.4 per cent are burned out each month. An inspector makes the rounds of the lamps, noting those in bad condition, and is followed by men who replace lamps and wash globes. Of a total operating cost of $800 per month, this inspection and cleaning service represents 0.3 cent per kilowatt-hour. An average lamp life of 2,600 hours is obtained.

Ward Harrison said that despite the small breakage of glass reflectors in factory installations, most owners prefer metal reflectors. Mr. Harrison declared standardization to be desirable, but insisted that the specifications be simple if they are to come into wide use.

The afternoon session opened with a

paper by R. F. Pierce on "Recent Improvements in Incandescent Gas Lighting." The author called attention to the fact that, while careful studies of the mantle have been made, little attention has been given to the development of burners. About two years ago the first serious research on the bunsen burner, as applied to gas lighting, was begun and this has shown that slight modifications in the design influence the effectiveness of the burner. The improvement which has resulted from such investigation shows a saving in the cost of gas lighting of 50 per cent.

This paper was discussed by W. H. Gartley, F. R. Hutchinson, G. S. Barrows, Norman Macbeth and A. J. Sweet. The latter described a combination gas and electric lighting installation in a Milwaukee building where, despite the assurances of the engineer concerning the reliability of electricity, the client insisted on having gas available as an auxiliary. Gas lamps were therefore employed on the stairs and at exits, no electric lamps being used at these points. In event of shutdown of the electric lighting, the gas fixtures are so distributed that enough light will be provided throughout the store to prevent panic, thieving, etc.

G. M. J. Mackay then presented a paper entitled "Characteristics of Gas-Filled Lamps."

This paper considers the suitability of tungsten as compared with other materials for use in filaments of incandescent lamps. Its superior qualities are due to high melting point, low vapor pressure and selective radiation. The benefits resulting from the introduction into the bulb of an inert gas are: Lessening of the rate of evaporation and the carrying of volatalized material to the upper part of the bulb by conduction currents in the gas. Curves giving the distribution of energy for daylight for the vacuum lamp and for lamps filled with nitrogen and mercury vapor are given. The latter has the most favorable properties. Heat-conductivity curves for nitrogen, argon and mercury vapor are given, the order of merit as regards this characteristic being mercury, argon, nitrogen. The chief advantage of helical winding lies in the diminished loss of energy by conduction of heat. A large diameter is desirable on this score, but for a straight wire, low voltages would have to be used to keep the power down to a suitable figure. Low-voltage units are objectionable on account of the conduction of the leading-in wires. The advantage of referring the characteristics of a lamp filament to temperature as a basis is emphasized. Tables of efficiencies are given for different sizes of wire and different temperatures in different gases.

W. R. Rollinson pointed out that few of the gas-filled lamps ever reach candlepowers as low as 80 per cent of their initial values, since they usually are broken before suffering this loss in intensity.

A. G. Worthing explained that the end loss to the terminals is much less in a coiled filament than it would be in a hollow cylindrical filament of the same outer diameter.

J. B. Taylor suggested that the temperatures and colors of various parts of the filament could be easily studied by projecting an enlarged image of the filament on a screen.

E. J. Edwards said that while the bulbs of the gas-filled lamps run quite hot, the heat actually produced depends of course upon the rating of the unit and is identical with that for any other type of lamp of the same rating. In this respect the gas-filled lamp actually comes nearer to delivering cold light than does any other illuminant. The coiled form of the filament introduces an inductance of about 0.6 milhenry per lamp. The resulting power-factor is over 99.9 per cent. The vacuum lamps on double voltage would last only a few seconds, whereas the gas-filled units require almost triple pressure to cause them to burn out in the same time.

W. A. Darrah declared that because of the absence of the limitations imposed by the incandescent lamp, such as melting of the filament at high temperatures, etc., some lamp of the arc type would be the final high-efficiency unit of the future.

E. J. Edwards then presented a paper entitled "The Lighting of Rooms Through Translucent Glass Ceilings."

The author studied the factors entering into the design of lighting systems for rooms having ceilings of translucent glass with light sources placed above. The limiting spacing is found to be proportional to the distance from lamps to the glass. The transmission efficiencies of 36 varieties of glass were determined and tabulated. These vary from 18 to 69 per cent.

In opening the discussion, A. J. Sweet defined specular, spread, and diffuse reflection, and compared the corresponding phenomena of light transmission through media giving direct, spread and diffuse transmission. Rough crystal glass gives spread transmission, and the "spots" of lamps behind it cannot be avoided except by increasing the distance between glass and lamps, so that the spots spread and merge with other spots. Where the distances available are short, opal glass may be used. This glass prevents spotting and has a transmission efficiency as high as 54 per cent.

E. B. Rowe said that opal-glass skylights appear flat and monotonous, while crystal-glass gives an attractive and sparkling effect.

W. A. Durgin said that for daylight transmission, skylight-glass efficiencies should not exceed 20 per cent, else the intensity beneath may become unbearable.

S. G. Hibben suggested that amber tints might be obtained more efficiently with lower-efficiency yellow lamps than with tinted glasses causing large absorption.

J. R. Cravath said that opal glasses will doubtless be developed to give lower absorption than those glasses now available.

F. C. Caldwell suggested using opal glass above to cut down the entering daylight, with crystal glass below to conserve and diffuse the light from artificial sources.

The last paper at this session was by H. H. Clark, and was entitled "Self-Contained Portable Electric Lamps for Miners."

This paper sketched briefly the history of mine illumination and described some of the primitive methods used to produce light in the early days of coal mining. Reference was made to the first attempts to make portable electric mine lamps and the lamps now used were described in detail. The author described the activities of the United States Bureau of Mines in connection with the development of portable electric lamps and outlined the requirements which lamps must pass in order to receive the approval of the Bureau. The paper closed with a brief discussion of the probable tendency of future portable-electric-lamp development.

George H. Stickney told of the limitations in weight, efficiency, duration of burning, etc., involved in the design of miners' lamps. Low-voltage lamps suffer a reduction in efficiency through the large heat-conduction losses at the ends of the filament More difficulty is also experienced in making the product uniform than with high-voltage lamps.

J. P. Langdon suggested the use of several cells in series, obtaining say 6 volts at the lamp. While involving a slight increase in weight, the filament end-losses would be reduced, enabling the center of the filament to be worked at a lower temperature for a given lamp efficiency.

R. P. Burrows explained that the wide distribution of the beam from the miner's lamp (130 degrees) is made necessary in order that the workman may see about him in the mine chamber in which he works. The shot-firers, on the other hand, need to have a relatively small area intensely illuminated.

Laboratory Sessions.

The first paper presented at the laboratory session on Wednesday morning was by C. E. K. Mees, and was entitled "Light Filters for Use in Photometry."

The author prepared two sets of four filters, one blue and the other yellow, for making color matches between

lamps of different efficiencies and daylight. Curves were given for the transmission of these filters at different wave-lengths.

The discussion was opened by E. F. Kingsbury, of Philadelphia, who inquired as to whether the dyes could be duplicated at any time and whether they would fade by exposure to light. The transmission depends upon the quality of the light used. Dr. Mees replied that the dyes could be duplicated from the spectrophotometric curves which are kept on record, but if the same dyes could not be obtained a new combination would have to be used to give the same result. All filters are checked before being sent out. The yellow filters fade in two days in direct sunlight, but the blue filters do not. In ordinary practice the life is indefinite.

W. F. Little, of New York City, referred to the use of the photometer with a filter as a pyrometer and inquired whether the absorption constant of the filter varied within the limits of color used. To this Dr. Mackay replied that the coefficient would be different. It is more advisable to use a blue filter in front of the standard lamp where the quality is constant. For different temperatures different filters would be used in front of the standard.

F. E. Cady, of Cleveland, inquired how the transmission coefficients given by the author were obtained and what their degree of accuracy was, to which Dr. Mees replied that they were merely rough values which indicated the order of magnitude and would not apply to all the filters sent out. Each of these would have to be calibrated before using.

L. J. Lewinson, H. E. Ives, J. B. Taylor, G. M. J. Mackay, C. S. Redding and C. H. Sharp also spoke.

A paper by H. E. Ives and E. F. Kingsbury entitled "Experiments with Colored Absorbing Solutions for Use in Heterochromatic Photometry," was then presented by Dr. Ives.

Colored Absorbent Solutions.

The authors have studied the proposal of Fabry to use colored absorbing solutions in photometric comparisons of light sources of different colors. Unexpected difficulties were encountered in applying these solutions and they were found inapplicable to the entire range of sources now available. A satisfactory yellow solution was developed by using cobalt-ammonium sulphate and potassium bichromate. The method of using this solution is described and results given for its transmission at different wavelengths. The practical difficulties of using such solutions are great, but when all precautions are taken they furnish a method to pass from a standard carbon lamp to illuminants of other colors.

The discussion was opened by F. E. Cady, who said the paper brought out clearly all the errors that may be encountered when using methods which appear to be simple. It emphasized the need of some standardizing laboratory acting as a referee by supplying colored filters or colored lamps having certified values which could be used to obtain a color match with any desired illumination.

C. E. K. Mees thought Mr. Cady's suggestion too much to put on any individual shoulders. Private laboratories should not be discouraged from working on the problem, since it had not yet been solved. Dr. Ives agreed with this point of view.

T. H. Amrine, of Harrison, N. J., said the use of such solutions appeared very attractive. He had tried it but found the standardization very difficult, as had been shown by the authors in this paper, and he had therefore abandoned it.

G. W. Middlekauff then presented a paper by himself and J. F. Skogland entitled "Characteristic Equations of Tungsten-Filament Lamps and Their Application in Heterochromatic Photometry."

Equations for Tungsten Lamps.

This paper gives an account of the difficulties experienced at the Bureau of Standards in calibrating lamps differing in color from the four-watts-per-candle carbon primary standards which maintain the international candle. It also proposes a method of overcoming the difficulties by the use of tungsten-filament secondary standards. These are measured at a match in color directly in terms of the primary standards, and their candlepower values at any other color are determined from the corresponding measured voltages. This is done by the use of characteristic equations which the authors have derived from the results of measurements of tungsten lamps of various sizes and makes. In determining these equations the difficulties due to color difference are dealt with once for all. Tables of values computed by means of these equations are given for use in practical photometry.

H. S. Dunning said that such work was very useful to the lamp manufacturers.

T. H. Amrine referred to the value of eliminating heterochromatic comparisons from every-day work. In the Edison Lamp Works at Harrison no photometric work is now done in either factory or laboratory involving a color difference. The characteristic curves are used to determine values where different colors are involved. He had found that the curves determined in that laboratory agree with those of the Bureau of Standards for the entire range.

P. G. Nutting said that there were three good methods which might be used for eliminating color difficulties in photometric work. One is to use a color filter; another is to stain the photometer screen on one side; and a third is to use a spectroscope to add the necessary color component to one side to give a color match. In the latter case the amount added is a small part of the whole, and high accuracy is not necessary in determining this component having a color difference.

E. L. Clark, C. H. Sharp, F. E. Cady, H. E. Ives, G. M. J. Mackay, John B. Taylor and E. F. Kingsbury also joined in the discussion.

Dr. Middlekauff then closed the discussion and pointed out that the accuracy of the formulas developed in the paper referred merely to their agreement with observed values, and was not to be regarded as absolute accuracy. He stated that similar formulas have been developed for gas-filled lamps, which were good to a value of 1.5 watts per candle. The formula for vacuum lamps holds to four watts per candle but not to a point corresponding to the pentane lamp.

A paper by P. G. Nutting and L. A. Jones entitled "A Transmission and Reflection Photometer for Small Areas," was then presented briefly by Dr. Nutting. This described a precision photometer for determining specular transmission or diffuse reflection in areas as small as one square millimeter, and with a special ocular as small as 0.01 square millimeters.

At the opening of the afternoon laboratory session, W. H. Gartley, past-president of the Society, and now president of the American Gas Institute, was introduced and made a brief address.

The first paper to be presented was one by P. G. Nutting entitled "Mixed Specular and Diffuse Reflection."

This paper referred to the reflecting properties of papers and similar materials where the glossiness of the surface is of importance. The author proposed to define glossiness as the ratio of specular to total reflecting power, and to define matness as the ratio of diffuse to total reflecting power. A formula is given for expressing these in terms of the apparent brightness of the surface.

P. W. Cobb pointed out that brightness and contrast are the elements which enable objects to be determined by vision. He pointed out that specular reflection may be somewhat diffused owing to the reflecting surfaces not lying in one plane. Dr. Nutting agreed that cases of this kind, like the reflection of sunlight on water, do not come under the formula given.

M. G. Lloyd pointed out that an ink surface upon a white background may be so glossy that for particular positions of the observer the ink may appear brighter than the background.

M. Luckiesh favored a definition of glossiness as the relative brightness of the glare spot and the surroundings. This value will depend, however, upon the way in which the paper is illuminated. The brightness of a glare spot depends upon the brightness of the source of light, while the diffuse illumination depends upon the distance from the source.

Dr. Nutting then presented a paper, prepared by L. A. Jones and F. A. Elliott in conjunction with himself, entitled "Some Tests of Possible Reflecting-Power Standards."

This paper dealt with the determination of the absolute reflecting power of various diffusely reflecting surfaces. Tables of values for different materials were given. With crystalline substances the values depend upon the size of grain and uniform results can be obtained only when they are finally powdered. The highest reflecting power found was for magnesium oxide after heating in a furnace.

A paper by N. K. Chaney and E. L. Clark, of the National Carbon Company, Cleveland, O., entitled "Notes on the Integrating Sphere and Arc-Lamp Photometry," was then presented by Mr. Chaney.

Integrating-Sphere Photometer.

After a brief historical introduction, the paper undertakes an exhaustive analysis of the characteristics of the integrating sphere, with special reference to the asymmetry in integrating properties arising from the necessary introduction of screens and opaque bodies. A mathematical expression is developed for the error of integration, which contains factors depending upon the reflecting power of the sphere walls; upon the relative size and position of the screen with respect to the light source, and to the photometric window; and upon the distribution of the light flux from the sources under comparison. Experimental data verifying the general theoretical conclusions are given. An earlier paper on this subject is criticized, particularly the statement regarding the use of translucent screens, and the measurement of extended light sources. The conclusion reached, is that translucent screens are not desirable and that extended light sources of sizes now common among modern arc lamps do not give erroneous values when measured in a properly designed sphere. A summary of the conditions which should be maintained in a sphere to secure accuracy is given. The method used in the photometrical laboratory of the National Carbon Company for comparing various carbons used in a variety of lamps is described. A rational method of proportioning the measurements made upon a single trim to the number of trims measured is given.

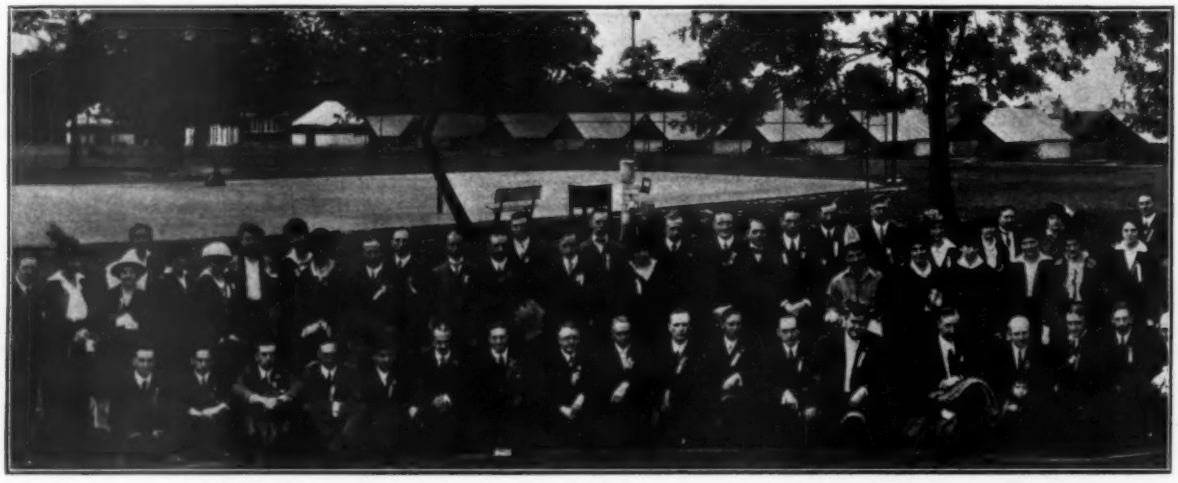
This paper was discussed by C. H. Sharp, W. F. Little, S. L. E. Rose, C. S. Redding, G. W. Middlekauff, F. E. Cady, T. H. Amrine, C. W. Jordan, R. C. Chillas, Jr., and E. L. Clark.

Dr. Sharp had been impressed with the wide misuse of the integrating sphere, and especially the translucent screen. Its precision is, however, remarkable when properly used. Mr. Little gave the results of experiments, using a diffusing screen, with an integrating sphere of 80 inches diameter. The source was mounted at different heights in the sphere. The results differed by less than one-half per cent with the translucent screen. With an opaque screen the differences were greater. This was with a bowl-frosted bare lamp. In one case where a reflector was used the differences amounted to three per cent with a translucent screen, and 10 per cent with an opaque screen. These results showed that either type of screen was very good for ordinary purposes. Comparisons between the spheres of larger and smaller diameters showed good agreement between them, even when arc lamps were used, and the error due to light falling upon the housing of the lamp was found to be negligible. He considered the integrating sphere more accurate than an apparatus which determined the spherical candlepower by distributed readings. The sphere used at the Electrical Testing Laboratory is coated with alabastine as often as it gets dirty.

Mr. Rose agreed with the authors that in testing electrodes it is well to use a large number with only a few readings on each, rather than to take a large number of readings on a few electrodes. If it is only desired to compare different electrodes the integrating sphere is satisfactory, but ordinarily a distribution curve is desired. White alabastine is used by the General Electric Company for a coating and it is found easier to repaint the sphere than to clean it. This is done about once a week, or whenever a series of tests is started with it.

Dr. Middlekauff stated that white alabastine was used as the coating for the sphere at the Bureau of Standards. The instrument there had not been much used after carrying out the acceptance tests. It was found better to use an opaque screen with area as small as possible. The instrument had been found accurate for comparisons of lamps of the same type. It is 30 inches in diameter. The color balances obtaining with illuminants outside of the sphere was often spoiled inside the sphere due to the absorption of the coating of the sphere.

Mr. Cady stated that there was no instrument of the kind at the Nela Research Laboratory, but that the engineering department of the National Lamp Works had one of 30 inches diameter. It was found to differ by as much as three per cent from a universal photometer. Mr. Amrine stated that no instrument of the kind was used at Edison Lamp Works.



Left Half of Group at Camp Nela During Convention of Illuminating Engineering Society.

Mr. Jordan stated that dust collected more in the lower hemisphere and errors would be caused by the difference in distribution if it were not clean. The sphere is used by the United Gas Improvement Company as a check on the measurements with the radial-bar photometer. They were found to agree to two per cent.

Mr. Clark stated that the sphere is painted about once in two weeks. A sphere of smaller diameter gives a higher intensity of light for the reading, but there is a larger error due to the screen.

Mr. Chillas pointed out that the reflection coefficients of wall paper and other objects could be obtained by using them as an inner coating of the sphere.

In closing the discussion, Mr. Chaney said that with lamps having different distribution the accuracy depended upon the ratio of size of screen to size of sphere. He thought that if the area of the screen was small the Bureau of Standards would have found less difference with lamps of different types.

L. A. Jones then presented a paper entitled "A New Standard Light Source."

The author proposed as a working standard a cylindrical acetylene flame viewed through a re-entrant window. This flame is almost an exact match in color with a tungsten lamp operating at 1.25 watts per candle. The results of investigations to determine the reliability of such a burner were given. The advantages claimed are constant intensity, good quality, accurately known spectral distribution and simplicity of apparatus.

This was discussed by E. L. Clark, C. H. Sharp, H. C. Chapin, C. O. Bond, S. L. E. Rose, M. G. Lloyd and E. F. Kingsbury.

In closing, Mr. Jones stated that the use of the re-entrant window reduces the parallax error to a negligible quantity. The lamp could be tipped to an angle of 10 per cent without appreciable effect. Acetylene was used from a commercial generator in which water was allowed to drop on the calcium carbide. There was no attempt to obtain chemical purity but the phosphene gas was removed. Upon re-charging, some air would be introduced, which was shown by a blue tip to the flame and the lamp was not used until this had disappeared. The value of the intensity was found to vary about two per cent from day to day. The lamp was used as a standard for a sensitometer, for which purpose it was much simpler in operation than an incandescent lamp standard.

At the session on Thursday morning the first paper presented was by E. C. Titus on "Some Uses of Light in the Treatment of Disease."

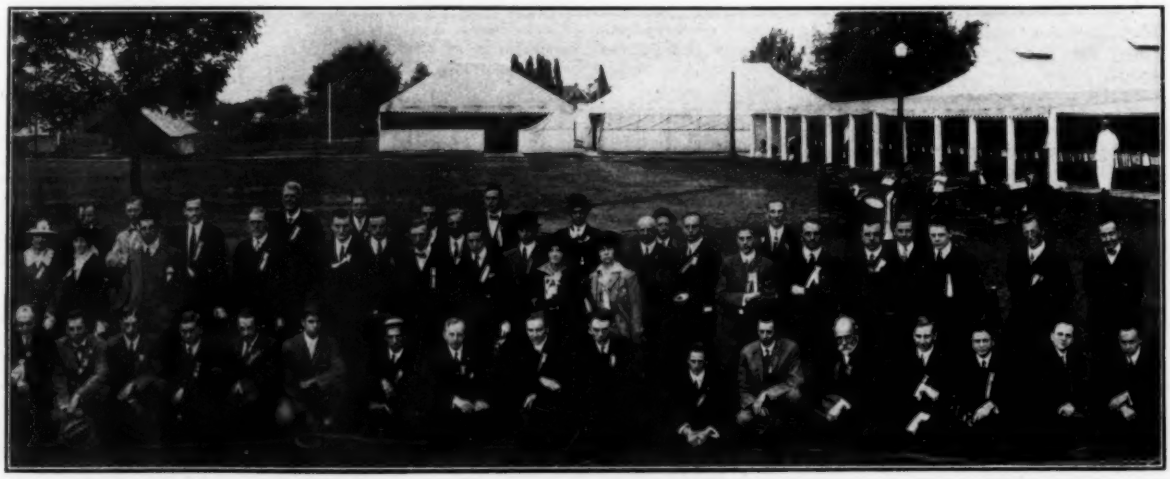
Light in the Treatment of Disease.

The value of radiation as a remedy in the treatment of disease is divided under the heads of thermic and actinic effect. For thermic effects the electric light bath is preferred to other means. The cabinet for this purpose should be lined with a diffusing surface and sources aggregating 4,000 watts should be arranged for control by switches. The cabinet should be partly open at the top and have an air vent at the bottom. Such treatment is beneficial in artereosclerosis, gout, rheumatism, Bright's disease, diabetes, obesity and catarrhal affections. The effects of the bath are to induce reddening of the skin with reduction of internal congestion, and the increase of elimination by lungs and skin. For actinic effects an arc lamp of 5,000 candlepower or high-power incandescent lamps may be used for local applications. Good results from such treatment have been secured in bronchitis, pleurisy, abdominal troubles, muscular rheumatism, neuritis, earache, etc. There seems to be a brilliant future for this treatment. The deleterious effects of X-rays are lessened by subsequent exposure to an arc lamp.

This paper was discussed by W. R. Mott, F. C. Caldwell, R. T. Ely, G. H. Stickney, J. B. Taylor, P. W. Cobb, George A. Hoadley, C. O. Bond, C. A. Littlefield and Dr. Sherman. Mr. Mott referred to the use of the flaming arc in the treatment of disease, for which purpose the two kinds of electrodes principally used are the blue and the snow-white. Calcium peroxide had been suggested for use in flaming-arc electrodes for this purpose, but an experiment with one containing 40 per cent of this material led to an explosion after five minutes of use. The candlepower of a white flaming arc increases as the square of the current. The ultra-violet light is important for the destruction of germs, and in designing apparatus to use this component of the radiation it should be noted that reflection coefficients are not the same as for the visible radiation. Thus silver was found to have a coefficient of only nine per cent in this part in the spectrum as compared with 90 per cent in the red. The fumes from flaming arcs are deleterious and must be removed, hence ventilation is important. The use of ammonium carbonate in the lamp inclosure with open arcs, such as used in a photographic studio, was suggested for the purpose of counteracting the nitric acid formed.

Mr. Ely stated that many practitioners come to the central-station companies for apparatus and seem to have no knowledge of the importance of the spectral distribution of the light in the lamp selected for the purpose. In the so-called electric baths many of them fail to use the more efficient types of lamp.

Dr. Cobb pointed out that heat had always been recognized as a therapeutic agent, that the method of applying it by radiation was superseding older methods and it is probable that radiation penetrates to a greater depth than heat supplied by conduction. The selection of the proper spectral distribution will intensify this



Right Half of Group of Illuminating Engineers and Guests at Camp Nela, National Lamp Works, Cleveland.

effect and he asked whether any study of the subject had been made from this standpoint. The translucency of the human tissues is made evident by holding the hand up in the sunlight.

Dr. Sherman considered the statements made in the paper extraordinary and did not consider that they had yet been verified by general experience.

J. R. Cravath then presented a paper entitled "Some Experiments with the Ferree Test for Eye Fatigue."

Experiments with the Ferree Test.

The Ferree test for eye fatigue was applied by varying the conditions of illumination, the conditions of work and the conditions of health successively. The results indicate the method to be sensitive to eye fatigue due to any of these causes and gives consistent results. A number of the tests were made by a bookkeeper working in a modern office building under different conditions of artificial illumination, five types being used. The illumination was about 4.25 foot-candles. In general, the loss of efficiency was greater for the direct lighting systems than for the indirect and semi-indirect.

The discussion was opened by Morgan Brooks, who told of reading fine type until the eyes were fatigued; then without any increase of illumination the use of a magnifying glass enabled the reading to be continued without straining the eyes. He explained this effect as due to pupillary contraction.

W. A. Durgin thought the results obtained in the paper agreed with the prior prejudices of the bookkeeper and were dependent upon what he had been accustomed to.

D. McFarlan Moore inquired whether the times when the object appeared blurred and when clear were affected by the heart beats. Where faint stars are seen discontinuously, the variation has been found to be in synchronism with the heart beats, indicating that the supply of blood to the retina is an important element.

F. C. Caldwell stated that he had used the method but had not yet concluded his experiments. He had not obtained any difference between indirect and direct systems of lighting where the latter was well designed, for illuminations between 1 and 3 foot-candles. Above 3 foot-candles fatigue increased rapidly with direct lighting. He pointed out the possible relation to psychological questions and the necessity of distinguishing between eye fatigue and mental strain.

C. E. Ferree pointed out the reasons for using his method, which gave good reproducibility of results, whereas all methods using an objective check were such as to affect the fatigue itself. He stated that there was no connection between the time of blurring and the heart beats. He considered it preferable to plot ratios of time blurred to time clear, rather than the actual time clear. He thought Mr. Cravath had placed the test object too close to the eye, and his results were not comparable because different times of test had been used. Nevertheless the results agreed with his own better than might be expected.

G. H. Stickney and E. B. Rowe also joined in this discussion.

Dr. Ferree then presented a paper by himself and G. Rand entitled "Further Experiments on the Efficiency of the Eye Under Different Conditions of Lighting."

Efficiency of the Eye Under Different Systems of Lighting.

This paper is a continuation of the papers presented to the Society in 1912 and 1913. It describes the completion of the plan of work outlined in the preceding papers for one set of lighting conditions for three of the tests thus far devised by the writer—a test of the ability of the eye to hold its efficiency for a period of work, a test for loss of efficiency of the fixation muscles, and a test for the comparative tendency of different conditions of lighting to produce discomfort. A report is also given of some miscellaneous experiments related to the hygienic employment of the eye in which the following points are taken up: the effect of varying the area and conversely the intrinsic brightness of the ceiling spots above the reflectors of an indirect system of lighting; the effect of varying the angle at which the light falls on the work in a given lighting situation; the effect of using an opaque eye shade with dark and light linings with each of the installations of artificial lighting employed in this and the previous work; the effect on the efficiency of the fixation muscles of three hours of work under these installations; the effect of motion pictures on the eye for different distances of the observer from the projection screen; and a determination of the tendency of different conditions of lighting to produce discomfort and a comparison of the tendency of these conditions to produce discomfort and to cause loss of efficiency. The general results with different conditions of lighting found in previous papers were verified and the results were not found to be explained merely by difference in the surface brightness in the field of vision. It was found preferable for eye shades to have a white rather than a dark lining. Experiments to determine whether the loss of efficiency was due to fatigue of the fixation muscles showed little difference in this element for the different systems of lighting. Motion pictures were found to give loss of efficiency which increased as the screen was approached, but in any case was no worse than that obtained under the worst conditions of ordinary use of the eyes.

After the inspection of the buildings and grounds of the National Lamp Works on Thursday afternoon, supper was served at Nela Camp, followed by a short business session. At this session prizes were presented to C. A. Littlefield and O. L. Johnson, who had captained the winning teams in the tug-of-war and baseball contests. M. H. Moffett called attention to the annual convention of the Jovian Order to be held in St. Louis in October.

H. M. Johnson then presented a paper entitled "Some Recent Experiments on Vision in Animals." This was accompanied by lantern slides. This paper consisted largely of acuity tests upon monkeys, chickens, dogs, cats and crows. The monkey was shown to have visual acuity similar to that of a man, while that of the chicken was one-quarter as good.

H. B. Dates, J. B. Taylor and C. E. Ferree discussed this paper.

A paper by P. G. Nutting entitled "The Visibility of Radiation," was presented by title.

The report of the Committee on Resolutions, consisting of M. G. Lloyd, L. B. Marks and L. B. Eichengreen was then presented by Chairman Lloyd. The resolution proposed, extending thanks to those who had participated in making the convention such a great success, was adopted.

The report of the Committee on the President's Address, consisting of J. B. Cravath, C. H. Sharp and George S. Barrows, was then presented by Mr. Cravath. The suggestion of adopting standards of interior lighting was regarded by the committee as a worthy ideal which we might hope to attain at some future time, but it was not considered feasible at present. The suggestion of popularizing the work of the Society was commended to the Council with a suggestion that the propaganda be extended to school children and the Illumination Primer circulated among them. Extension of the sustaining membership was also approved. The report was adopted and the convention adjourned.

Entertainment.

On Monday evening a reception and ball was held at the Hotel Hollenden and dancing was indulged in until midnight. During the intermission Miss Vida N. Cotabish gave an exhibition of popular dances.

On Wednesday evening a banquet was held, W. H. Gartley acting as toastmaster. Formal responses were made by L. B. Marks, the first president of the Society; Charles O. Bond, the present president; A. S. McAllister, the president-elect; and by Charles F. Brush, the well known electrical inventor of Cleveland. Informal remarks were also called for from E. P. Hyde, Herbert S. Ives, Norman Macbeth, and F. E. Wallace, the architect of Nela Park. A gavel was presented to Clarence L. Law, representing the New York Section, for having the best attendance, distance considered.

On Tuesday visits were made to the plants of the National Carbon Company, Cleveland Electric Illuminating Company, White Automobile Company and the American Steel & Wire Company.

On Thursday afternoon the laboratories and grounds of the National Lamp Works were inspected. Dinner was served here, after which motion pictures were displayed and dancing indulged in. Special automobile trips were provided for the ladies in the afternoons.

New Electrical and Mechanical Appliances

New Operation for Small Canopy Fixture Switches.

The small push-and-pull canopy switches made by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., formerly operated to close the circuit when the button was pushed in, while when it protruded the circuit was open. There has been a demand also for switches operating in just the opposite way and these have now been added to the standard line. They are used considerably on wall brackets controlled with the ceiling chandelier by a wall switch. The wall brackets being used only occasionally, the buttons therefor remain pushed in. When the chandelier is lighted, the

Bracket With Canopy Switch.

circuit to the wall brackets is not closed unless the buttons are pulled out. The bracket shown in the accompanying illustration and made by R. Williamson & Company, Chicago, is equipped with a C-H canopy switch with the reverse mechanism as mentioned above.

American Lamp Bulbs Exported.

The Libbey Glass Company has received at its Sandusky, O., offices an order for 5,000,000 incandescent electric lamp bulbs for foreign shipment. The order came by cable from London. Weekly shipments are being made. The war in Europe is said to have played havoc with the glass business, especially in Belgium. The European order came to the Libbey Glass Company unsolicited and is a marked indication of the shortage in the supply of electric light bulbs in Great Britain, which has largely been supplied heretofore from Continental sources.

New Molded Insulation Cover for Dossert Connector.

There has been a great demand for a connector having an insulated cover, for use without solder for the small sizes of wires. Heretofore this demand has been largely met by the Dossert special No. 1 connector but as this connector was designed to take all sizes of wires and cable from No. 1 to No. 14, the range was believed to be wider than necessary.

Dossert & Company, 242 West Forty-first Street, New York City, announces the production of a molded insulation cover for use on its regular No. 4 connector. This will take all sizes of wire from No. 4 to No. 14. Many thousands of these connectors are now in use for connections on transformers, motors, meters, sectionalizing cases for signal apparatus, and other connections where it is desired to use a connector without solder and that may be disconnected when desired, but which when in place pro-

Connector With Molded Insulating Cover.

vides a joint having high conductivity and is efficient, safe and time-saving.

By making the insulating cover for the regular No. 4 connector, the fitting is reduced in size and with less material there is also a reduction in cost to users of about 20 per cent as compared with the cost of the connector and cover heretofore supplied for small sizes of wire. With these connectors various size bushings are provided, the outside diameters of which fit the connector while the inside diameters correspond to the size of the wires that it is desired to connect.

New Porcelain Receptacles.

In line with its policy of extending the utility of the varied assortment of its Unilet fittings, the Appleton Electric Company, Chicago, Ill., has recently placed on the market a number of new weatherproof porcelain receptacles designed particularly for adaption to Unilets. One of the illustrations shows two of these of the one-piece type that are made for use on one-half-inch, three-quarter-inch and

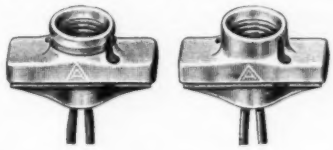


Fig. 1.—Receptacles for Rectangular Unilets, With and Without Shade-Holder Groove.

one-inch rectangular steel Unilets. These receptacles are made both with and without a groove for attachment to a shadeholder. In each case the receptacle is secured to the top of the Unilet by means of two screws.

Fig. 2 shows other new weatherproof porcelain receptacles that are made in two types, one of the straight

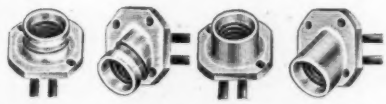


Fig. 2.—Straight and Angle Receptacles for Octagon Unilets.

pattern and the other angular. In each case these are provided with or without the shade-holder groove. These receptacles are intended for use on one-half, three-quarter and one-inch octagon steel Unilets. Like the foregoing, these receptacles are secured to the body of the Unilet by means of two screws.

The company has also added a new

Fig. 3.—Push-Button Switch Cover.

push-button switch cover, shown in Fig. 3. This is for use on four-inch round outlet boxes and will take in all the standard push-button switches, flush rotary switches or plug receptacles. Both the porcelain fittings and the push-button switch cover have been approved by the Underwriters' Laboratories.

New Oil-Testing Set.

With high-voltage oil-insulated apparatus, in order to insure successful operation, it is necessary to maintain the dielectric strength of the oil at maximum value. A testing set has recently been developed and placed on the market by the General Electric Company for determining the dielectric strength of oil.

This set consists of a testing transformer with an induction regulator for voltage control and an oil spark gap. All of the various parts are assembled and mounted so as to form one complete unit, which is very compact and neat in appearance and, at the same time, may be conveniently and quickly operated. The set is built for both 25 and 60 cycles.

The transformer has a rating of three kilovolt-amperes at 30,000 volts, but may be operated at 10 per cent above this figure. The high-voltage winding

Oil-Testing Apparatus.

is equipped with a voltmeter coil for indicating directly the test voltage. The transformer tank is of drawn seamless steel and the cover is fitted so as to be oil tight, permitting shipment filled with oil. The induction regulator is specially designed for the testing set and allows a variation of the test voltage from zero to maximum. The regulator, as well as the transformer, is arranged for series-parallel connection, making the set suitable for use on 100 or 200-volt circuits. A dial is attached to the top of the rotor shaft of the regulator and is accurately graduated to give readings of the test voltage directly in kilovolts.

The set may also be equipped with a small portable voltmeter for reading the test voltage, provision being made on all outfits for mounting an instrument specially designed for the set. This instrument is of the dynamometer type, is very accurate and the scale is graduated to read the test voltage in kilovolts.

The oil is tested between flat metal discs, which are located inside the receptacle. One electrode is stationary, and the other has a micrometer adjustment with an adjustable zero index. This permits taking up readily any wear in the gap. The receptacle is designed so that it may be very conveniently cleaned. Care has been taken that the quantity of oil required for tests is as small as is consistent with good results. It is estimated that three-quarters of a quart of oil is sufficient for one sample, allowing five tests on clean oil.

The oil receptacle and spark gap are supported by the high-voltage terminals of the transformer. By merely turning the receptacle about its horizontal axis, the oil which has been tested may be emptied, being caught by a depression in the transformer cover and flowing away through a pipe.

The receptacle and gap may also be easily removed from the supports, leaving the transformer free for high potential testing of any kind up to 33,000 volts.

Oil-Testing Spark Gap.

This apparatus is also equipped with a small sensitive circuit-breaker of novel design, which is attached to the side of the regulator and is likewise specially designed for the apparatus. The set may also be mounted on a truck, making it portable.

The outfit is complete in every essential detail, being all assembled in one unit, which makes it compact and convenient to operate and easy to obtain quick and accurate results. The use of the induction regulator for voltage control produces no noticeable distortion of the electromotive-force wave shape and therefore contributes considerably to the accuracy of the test results.

The weight of the 60-cycle set complete is 465 pounds, height 30 inches, length 24 inches, width 17.5 inches; and the weight of the 25-cycle set complete is 670 pounds, height 32 inches, length 26.5 inches, width 20.5 inches.

A New Line of Armored Cable and Flexible Steel Conduit.

A new line of steel-armored cables and flexible steel conduits has been placed on the market by the Trumbull Electric Manufacturing Company, of Plainville, Conn. It is designated by the company's well known trade name "Circle T." This new line is very complete and is made both in twin-conductor and triple-conductor cables; these cables are also furnished as lead-covered and steel armored. They are made in five sizes, ranging from No. 14 to No. 4 wire. The three larger sizes are made of stranded conductors. The flexible-steel conduit is made in four sizes, ranging from one-half to one and one-quarter-inch inside diameter. The company has also added a line of armored cord.

The new conductors and conduits are made of high-grade materials. Special care is taken in all details of the construction. The design is such as to make these cables and conduits possess exceptional flexibility. These materials are made in the company's own factory under the most approved conditions and with the best machinery obtainable.

New Armored Cable.

An Excellent Example of Slack Belt.

That real slack belts on short centers are quite practical is conclusively proved by the accompanying illustration, which shows a five-inch single leather belt transmitting power from a 15-inch to a 33-inch pulley. The distance from center to center of shafts is only five feet. The speed of the driving pulley is 500 revolutions per minute.

This belt, operating in the engine room of the Lambeth Public Baths, Kensington Road, London, S. E., England, drives two 36-inch towel-washing machines, one 36-inch fan, one 36-inch roller mangle and one 38-inch hydro-extractor.

Before treating with Cling-Surface great difficulty was experienced in keeping this belt on the pulleys, even with much tension, and this great tension caused the bearings to overheat.

Slack Belt Drive in Engine Room of Public Bath.

a trouble that was enhanced by the high temperature in the engine room, 100 degrees Fahrenheit at the time the photograph was taken.

The exceptional slack made possible by the use of Cling-Surface has permitted the removal of all initial tension except that due to the weight of the belt and is said to have been the means of a 25-per-cent increase in the pulley-contact areas. The belt no longer runs off the pulleys for there is no slip.

Western Electric Washing-Machine Campaign.

There have been so many really meritorious electric washing machines placed on the market recently that competition has indeed become keen, with the result that in this field, at least, many ingenious and result-producing campaigns have been prosecuted. The large number of machines in constant service today is a credit to the perseverance and ingenuity of the workers in this particular line, for in spite of the superior advantages of the electric method, it has been no easy task to introduce the electric washing machine into the homes of the middle class whose tendency it was to look upon electric appliances as luxuries.

The Western Electric Company is one of the larger companies that has recently entered the field with an electric washing machine, the merits of which are already well known to a large percentage of the reading public. National advertising, on a large scale, is being used to acquaint the public with the advantages of the Western Electric washer and this publicity is being supplemented by aggressive sales campaigns in various localities.

In Chicago, W. B. Pierce, manager of the company's washing-machine department, is personally supervising a campaign that is producing excellent results. Fortified with ideas and arguments gained during six years' experience in the handling of domestic appliances for the company, Mr. Pierce is establishing a record for the sale of washing machines that will be difficult to equal. He has assembled a corps of salesmen and demonstrators who obtain names of prospective purchasers either as a result of the company's direct-by-mail advertising or magazine advertising, or by personal canvass and to these an actual demonstration of the machine is made on the regular wash day of the prospect. The machine is then left on trial for a period of 15 days. It is stated that only a very small percentage of the washers so placed are returned.

For the first time in the history of the Western Electric Company a deferred-payment plan has been adopted in its sales work and Mr. Pierce feels that much of his success is due to this system of selling.

As a part of the local campaign, space was engaged at the recent Home Exposition, held at the Coliseum, Chicago, September 14 to 26, and an exhibit of washing machines maintained. Mr. Pierce had his entire sales force present in order to properly handle the large number of inquiries received. It is stated that the attendance at this show was unique in that most of those present came to actually make purchases. The Western Electric Company actually sold from its booth several dozen machines during the course of the show.

The local campaign, stimulated by the results so far achieved and by the encouraging number of prospects resulting from the demonstration at the Home Exposition, will be continued with renewed vigor and Mr. Pierce looks for even greater results in the near future.

Selling Washing Machines by Automobile.

A hustling believer in the value of live advertising is A. B. Keaton, of Santa Rosa, Cal., an agent of the Western Electric Company, who is reaping the benefit of quick sales due to his practical method of demonstrating and exploiting Western Electric washing machines by automobile. Mr. Keaton travels from town to town with the washing machine in his automobile. It can be easily removed and taken into the home of his prospective customer for a demonstration or left for 10 or 15 days' free trial. This tactful method of demonstrating is largely responsible for his success.

Washer Exhibit at Household Exposition.

Current Electrical News

NORTH ATLANTIC STATES.

BANGOR, ME.—Waldo-Penobscot Light & Power Company has been organized for the purpose of making, generating, selling, distributing and supplying electricity for lighting, heating and power purposes, with $300,000 capital stock. Nelson H. Hydron, of Bangor, is president.

MANCHESTER, CONN.—Citizens of the North End are agitating for a "White Way" to cost about $1,050, half of which it is proposed to raise by subscription among business men.

WATERTOWN, N. Y.—Eaton & Brownell, of Watertown, have completed a preliminary survey for another mammoth hydroelectric plant on the Oswego River. It is reported specifications will be drawn in the near future and bids asked. The new building would take the place of the old one at the Oswego Falls Pulp and Paper Company's plant at the east end of the upper dam.

NEWARK, N. J.—In connection with its new factory to be erected on Frelinghuysen Avenue, the Beaver Leather Company will build a power plant to cost about $13,500. A.

LEWISTOWN, PA.—Louis Roth & Company, engineers, Denckla Building, Philadelphia, Pa., are in charge of the project for a lighting plant for this place.

SOUTH ATLANTIC STATES.

BECKLEY, W. VA.—Beckley Utilities Company plans to expend $100,000 to construct an electric light plant and $60,000 to construct water works.

LOGAN, W. VA.—Logan County Light & Power Company has been incorporated with a capital stock of $1,500,000, by W. C. Lawrence, Jr., Logan, W. Va.; B. C. McComas, Barboursville, W. Va.; George W. Stevens, Jr., E. S. Aleshire, R. P. Aleshire, of Huntington, W. Va.

WHITEVILLE, N. C.—J. A. Newsome, Jacksonville, Fla., contemplates establishing an electric light system.

BULLOCHVILLE, GA.—W. B. Butts and E. A. Williams have made application for incorporation of Bullochville Electric Lighting Company, to generate electricity and furnish it for lighting purposes, and to deal in electric fixtures. The capital is $1,000 with privilege of increasing to not exceeding $50,000.

LEESBURG, GA.—J. B. McCrary Company, municipal engineers, Atlanta, Ga., are preparing estimates for a $30,000 electric light plant and for other purposes. Address J. B. Gaines, mayor.

JACKSONVILLE, FLA.—Electrical Superintendent W. H. Tucker will recommend to the Board of Bond Trustees that a new 5,000-kilowatt engine be purchased to provide for increasing demand for electricity. The new equipment will cost about $60,000.

NORTH CENTRAL STATES.

CINCINNATI, O.—Electrical equipment will be required in connection with water plants to be built at Dayton, Middletown and Xenia, O., which will cost, it is estimated, respectively, $750,000, $150,000 and $70,000. Pollard & Ellms, engineers in the Union Central Building, are in charge of the projects. L.

CAMBRIDGE CITY, IND.—The matter of further improvement of the electric lighting system on Main Street is under consideration. Address Superintendent Gentry for general information.

BEAR LAKE, MICH.—The Benzer County Power Company has petitioned for a franchise to light Bear Lake with electricity.

VANDERBILT, MICH.—John Yuill of this place is planning to develop water power to light Gaylord and Vanderbilt.

BIG FALLS, WIS.—The Big Falls Light Company has been recently organized. O. H. Tetzlaff is president and R. Konopatzka, secretary.

ELK RIVER, MINN.—The Elk River Council has granted F. D. Waterman an electric light franchise.

CORNING, IOWA.—The City Council will call a special election soon to vote on the proposition of installing an electric light plant to be owned by the city.

SOUTH SIOUX CITY, IOWA.—Citizens recently voted to establish a municipal electric system to cost about $10,000. C.

KIRKWOOD, MO.—The Board of Aldermen have authorized improvements to the electric light plant costing $17,000; Board of Public Improvements to be in charge.

MOHALL, N. D.—At a special meeting of the City Council, an ordinance passed first reading granting Louis Heiner a franchise to construct an electric light plant in this city.

HEOLA, S. D.—A petition is being circulated for an electric light system. Address the village clerk.

DE WITT, NEB.—The city council is considering plans for establishing an electric light plant to cost about $15,000. Address the village clerk.

SOUTH CENTRAL STATES.

PRINCETON, KY.—Municipal installation and operation of an electric light and power plant depends upon the action of the voters who at the coming November election will pass upon the proposal to issue $15,000 of bonds for that purpose. R. W. Lisanby is mayor and T. J. Johnson, city clerk. G.

FLORENCE, ALA.—Allentown Power Company has been incorporated with a capital of $200,000. N. E. Thompson, of Birmingham, is president. The company recently purchased a large tract of land on Cypress Creek, just west of Florence, with riparian rights to give water power. The company will immediately build two hydroelectric power plants.

WESTERN STATES.

MALTA, MONT.—A petition to construct an electric light and power plant, and to furnish this city with electric current for power and light, has been placed before the Council by Shade & Levesconte, of this city.

MALAD, IDAHO.—Work on the construction of what will be considered the best individual power plant in Southern Idaho, same to be built in this city, will begin in the immediate future by the Evans Electric Light Company. The contracts for generating equipment, etc., have not been let.

TUCSON, ARIZ.—The Common Council has asked for bids for the supplying of electrical equipment for the municipal lighting system. Detailed specifications and drawings may be had from the city recorder, Tucson, Ariz.

SEATTLE, WASH.—A resolution has been adopted by the Council which provides for the installation of a cluster lighting system on a portion of Madison Street. A. L. Valentine, chairman, Board of Public Works, will shortly call for tenders for materials and installation of same. O.

BAKER CITY, ORE.—The Dry Gulch Ditch & Electric Power Company has succeeded the Dry Ditch Company at this place, and will erect a hydroelectric power house at a site on Eagle Creek where a fall of 200 feet can be secured.

DRAIN, ORE.—Officials of the Douglas County Water & Light Company, here, are authority for the statement that $20,000 will be spent immediately in extending an electric transmission line from Winchester, where the company's power plant is located, to this city. C.

SUMMERVILLE, ORE.—The power and light transmission lines of the Kless Electric Company here, will be extended into the Grand Ronde Valley in the immediate future, and power furnished to the villages *en route*.

WARRENTON, ORE.—A 30-year franchise to furnish power and light to this city has been granted by the Council to the Pacific Power & Light Company, of Astoria. The work of extending the power transmission lines and of installing necessary equipment will cost $50,000, or more.

SAN FRANCISCO, CAL.—The Board of Supervisors has passed an ordinance ordering the installation of electric conduit throughout the civic center.

SANTA CLARA, CAL.—An electric lighting system is to be installed at the Santa Clara University.

PROPOSALS.

FIRE-ALARM SYSTEM.—John S. Wise, city clerk, Galena, Ill., will receive sealed proposals until October 5 for furnishing and installing a fire-alarm system for the Fire Department.

ELECTRIC LIGHTING SYSTEM.—Bids will be received October 5 for the construction of an electric lighting system and water works in Scottsville, Va. Address E. L. Fox, chairman Water and Light Committee.

ELECTRIC LIGHT PLANT.—Bids will be received on October 6 for the construction of an electric light plant in Melville, La., payment for the same to be made in bonds. Address W. L. Thompson, engineer in charge of construction.

ELECTRIC WIRING.—Bids are now open at the County Commissioner's office of Lawrence County, at New Castle, Pa., for the electric wiring of the Lawrence County jail. For information address James B. Lamoree, Clerk, County Commissioner Office, New Castle, Pa. S.

CABLE.—Sealed proposals will be received by the War Department, Office of the Chief Signal Officer, Washington, D. C., until October 3 for furnishing under proposal No. 720, 13,000 feet cable, five-pair, type 305. For further information apply to Charles S. Wallace, captain, signal corps, U. S. Army.

A CONDUIT AND WIRING SYSTEM.—Sealed proposals will be received October 22 for a conduit and wiring system and lighting fixtures at the United Sates appraiser's warehouse, New York, N. Y., in accordance with drawings and specifications, which may be obtained from the supervising architect.

ELECTRIC MOTOR.—Sealed proposals will be received at the office of the General Purchasing Officer, Panama Canal, Washington, D. C., until October 10 for furnishing under Circular 868D one automobile hose car and one electric motor. For copy of circular address F. C. Boggs, general purchasing officer.

TURBINES AND COMPRESSORS.—Sealed proposals will be received at the United States Engineer Office, Wheeling, W. Va., until October 26 for furnishing and delivering two 60-horsepower water turbines and two 250-cubic-feet air compressors at dam No. 28, Ohio River. For further information apply to J. P. Jervey, major, engineers.

ELECTRICAL EQUIPMENT.—Sealed proposals will be received on October 5 by the City of Ely, Minn., at the office of I. Wisted, Jr., city clerk, for one 100-kilovolt-ampere alternating-current engine-type generator; one steam engine for direct connection to above generator. Plans and specifications are on file at the office of I. Wisted, and W. C. Buck, consulting engineer of Minneapolis.

ELECTRICAL EQUIPMENT.—Sealed proposals will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until October 13 for furnishing 80 20-volt water-tight buzzers, for delivery at the Navy Yard, Philadelphia, Pa.; 40,000 feet telephone cord, 95,000 feet silk double-conductor wire, miscellaneous magnet wire, all as per Schedule 7352, for delivery at the Navy Yard, Brooklyn, N. Y.; miscellaneous weatherproof sockets, for delivery at various yards, as per Schedule 7197. The Bureau will also receive proposals until October 13 on eight motor-driven steel baskets, as per Schedule 7343, for delivery at the Navy Yard at Washington, D. C., and for miscellaneous electrical fittings, as per Schedule 7347, for delivery at the Navy Yard, Annapolis, Md.

FOREIGN TRADE OPPORTUNITIES.

[Where addresses are omitted they may be obtained from the Bureau of Foreign and Domestic Commerce, Washington, D. C., and at the branch offices at New York, N. Y., Chicago, Ill., New Orleans, La., San Francisco, Cal., Atlanta, Ga., Seattle, Wash., and Boston, Mass. Apply for addresses in letter form, giving file numbers.]

NO. 13,817. X-RAY TUBES.—An American consul in Europe advises that an X-ray specialist in his district desires to receive at once catalogs and price lists from American manufacturers of X-ray tubes for therapeutics and diagnosis.

NO. 13,710. ELECTRICAL DRYERS.—An American consul in Canada reports that a corporation in his district desires to be put in touch with manufacturers of or dealers in electrical clothes-drying machines.

NO. 13,714. LAMPS, MAGNETOS, HORNS, ETC.—An American consular officer in England advises that a company manufacturing motor, motor cycle, and bicycle lamps, horns, magnetos, and an importer of motor cycle and bicycle accessories desires to negotiate with American manufacturers of these goods. The company offers cash within 30 days.

NO. 13,715. ELECTRICAL SUPPLIES.—A firm in Canada reports to an American consular officer that it desires to be placed in touch with American manufacturers of electrical supplies and devices who would like to be represented in a good market of that country.

NO. 13,730. ELECTRICAL ELEVATORS AND SUPPLIES.—A large electrical supply house in southern Europe advises an American consul that it desires to establish relations at once with American manufacturers of electrical elevators, electrical machinery, and supplies.

NO. 13,734. WIRE AND BULBS FOR ELECTRIC LAMPS.—An American consul in Norway reports that a large wholesale house in Europe wishes to purchase wire and bulbs for electric lamps (Edison system), also vulcanized cables for installations.

NO. 13,758. ARMORED CABLES.—An American consul in Great Britain reports that a large engineering company in his district desires the names of a few well-known United States firms who are in a position to manufacture and quote favorably for paper-insulated lead-covered and armored cables for high and low-tension service. It is desired to determine at an early date whether the American firms can meet the requirements.

NO. 13,760. ELECTRICAL SUPPLIES.—A British electrical company informs an American consul that it desires to enter into business relations with American electrical manufacturers supplying arc lamp carbons, suitable for all types of arc lamps; small porcelain fittings, and lamp holders of all kinds of the bayonet type.

FINANCIAL NOTES.

The Executive Committee of the Interborough Rapid Transit Company was reduced from seven to five members yesterday by a vote of shareholders at the annual meeting. The committee is composed of August Belmont, E. J. Berwind, Andrew Freedman, Theodore P. Shonts, and Cornelius Vanderbilt.

The trustees of the Chicago Railways have called an open meeting of certificate holders October 21 to discuss any matters they want to bring up and to choose directors for the ensuing year, whom the trustees will elect October 22.

The protective committee of the first-mortgage bondholders of the Lehigh Traction Company has mailed a circular letter to the bondholders advising them to accept the offer of Alvin Markle, president of the company, to purchase for his personal account the unpaid interest coupons of June 1, last. The coupons must be presented on or before November 1, and those who have deposited bonds with the committee are asked to authorize acceptance of the offer.

Mason B. Starring, president of the United Railways Investment Company, has issued a circular letter to stockholders setting forth the condition and earnings of the Philadelphia Company, one of the subsidiaries of the Investment company, and explaining that it was due to the unprecedented financial condition growing out of the European war that the directors of the Philadelphia Company deemed it wise to pay the quarterly dividend on the common stock in scrip. The Investment company, according to the last annual report, owns 484,000 shares of common stock of the Philadelphia Company, in consequence of which it will receive the scrip, which bears interest at seven per cent, payable semi-annually, and matures on or before May 1, 1916. President Starring states to stockholders: "Until December 31, 1914, the company offers to its stockholders the opportunity to purchase its portion of such scrip, subject to prior sale, at par and accrued interest from November 2, 1914." The circular also announces that the interest on the United Railways Investment Company trust sinking-fund five-per-cent bonds (Pittsburg issue), due November 1, 1914, will be paid in cash as usual.

Dividends.

	Term	Rate	Payable
Bell Tel. of Pa.....	Q	1.5%	Oct. 15
Cent. & S. Am. Teleg.	Q	1.5%	Oct. 8
Cin. St. Ry.	Q	1.5%	Oct. 1
Cont. Gas & Elec., pf..	—	1.5%	Oct. 1
Cont. Gas. & El., com.	—	0.5%	Oct. 1
Dallas Elec., 2d pf.....	Q	$2.50	Oct. 13
Dallas Elec., 1st pf....	Q	$3.00	Oct. 13
Elec. Util., pf.....	Q	1.25%	Oct. 15
Kansas Gas & Elec., pf.	Q	1.75%	Oct. 1
Memphis St. Ry. Co..	Q	1.25%	Sept. 24
Mexican Tel. Co.....	Q	2.5%	Oct. 15
Otis Elevator, pf.....	Q	1.5%	Oct. 15
Otis Elevator, com.....	Q	1.25%	Oct. 15
Ottawa Power	Q	2%	Oct. 1
Phila. Co. (scrip).....	Q	1.75%	Nov. 2
Phila. Co., pf. (scrip)..	Q	3%	Nov. 2
Puget Sd. Tr., St. & Pr.. pf.	Q	$1.50	Oct. 15
Tri-City Ry. & Lt.....	Q	1%	Oct. 1
Tri-City Ry. & Lt., pf..	Q	1.5%	Oct. 1
West. Ohio Ry., 1st pf.	Q	1.75%	Oct. 1
Westinghouse Elec. & Mfg., com.	Q	1%	Oct. 30
Westinghouse Elec. & Mfg., pf.	Q	1.75%	Oct. 15

Report of Earnings.

COMMONWEALTH POWER, RAILWAY & LIGHT.

	1914	1913
August gross.....$	210,584	$ 201,221
Net after charges...	151,052	143,958
Balance after dividends	71,052	63,958
Twelve months' gross	2,994,950	1,870,095
Net after charges....	2,222,572	1,572,158
Balance after dividends	1,262,572	1,012,158

PERSONAL MENTION.

PROF. C. E. CLEWELL, formerly at Yale University, has accepted a position upon the faculty of the University of Pennsylvania.

MR. JOSEPH D. ISRAEL, district manager of the Philadelphia Electric Company, and serving his third year as secretary of the Illuminating Engineering Society, has resigned the latter office, to take effect upon the selection of a successor.

MR. O. L. JOHNSON, of the Benjamin Electric Manufacturing Company, has been appointed secretary of the Chicago Section of the Illuminating Engineering Society, vice H. B. Wheeler, resigned.

MR. J. O. PRESBREY, while attending the recent convention of the Holophane Works of the General Electric Company, effected arrangements whereby a new territory to be known as the Inter-Mountain territory has been created, consisting of the states of Utah, Idaho, Wyoming, Montana, Colorado, New Mexico, and Spokane and El Paso. Mr. Presbrey will have charge of this territory with headquarters at Salt Lake City.

MR. J. M. MONCRIEFF, Bloomington, Ind., has been selected to succeed MR. A. W. HIGGINS as manager of the La Crosse Gas & Electric Company. Mr. Higgins has been transferred by the American Public Utilities Company to Indianapolis, there to be president and general manager of Merchants Heat & Light Company. The properties there include the largest central heating plant in the world and the selection of Mr. Higgins for the position is a decided compliment. The new manager has been general manager of the water, gas and electric plants at Bloomington, Ind.

MR. WILLIAM D. KERR, who has occupied the position of director of the Bureau of Public Service Economics, New York City, since the organization of the Bureau, has tendered his resignation and will resume his law practice October 1, at 19 South La Salle Street, Chicago, Ill., where he will devote special attention to matters affecting the relations between public utilities and the public. He is also to lecture on transportation law in the Northwestern University School of Commerce. The activities of the Bureau will not be interrupted, although some interval may elapse before the appointment of a new director.

MR. HARRY WINDER has been placed in charge of the Chicago office of the American Conduit Manufacturing Company, of Pittsburgh, Pa. Mr. Winder is one of the best known and most popular electrical representatives in the country. He is a member of the Jovian Order and a number of electrical clubs, as well as being an associate in several of the leading engineering societies. Mr. Winder will be located in Chicago during the absence of MR. FRANK R. BRYANT, formerly in charge of the American Conduit Manufacturing Company's affairs. Mr. Bryant has found it necessary to live in the southwest for the winter.

MR. RUSSELL E. GREEN, representative of the Standard Underground Cable Company at Chicago, has been appointed manager of th Detroit office, which the company opened on October 1. Mr. Green has been engaged in the electrical and allied fields for the past 10 years and since 1909 has been associated with the Standard Underground Cable Company. He has, for the past year, spent considerable time in Detroit and the opening of an office in that city was found necessary to properly handle the rapidly increasing business. Mr. Green is well known

R. E. Green.

in Chicago and the Middle West and leaves for Detroit with the best wishes of all his friends. He is a member of the American Electric Railway Association, Association of Railway Electrical Engineers, Illuminating Engineering Society, Sons of Jove, Electric Club of Chicago and the Industrial Electrical Engineering Society of Detroit.

OBITUARY.

MR. RICHARD W. SEARS, one of the leading business men of America and a founder of Sears-Roebuck & Company, died at Waukesha, Wis., on September 28. Mr. Sears retired in 1909 with a fortune estimated at $25,000,000. He began his career as a telegraph operator for the Great Northern Railroad at Redwood Falls, Minn. He was 51 years old.

CAPTAIN ROBERT McCULLOCH, president Chicago City Railway Company from 1900 to 1904, and president of the United Railways of St. Louis, Mo., died in that city on September 28. Captain McCulloch spent practically all of his life in harness. He was at his desk every morning at 6:30 until a short time before he died. He was born on December 7, 1863, in Missouri, and graduated from the Virginia Military Institute shortly before the outbreak of the Civil War. He inlisted in the Confederate Army under General Bradstreet and was soon promoted to be a captain. He was wounded and captured in a charge at the Battle of Gettysburg and was with General Lee at the surrender at Appomattox. After the war he went to St. Louis where he worked himself up from the position of horse-car driver to general manager. He left that city for four years, during which time he acted as president and general manager of the Chicago City Railway Company, operating the south side lines, succeeding Mr. M. K. Bowen. Captain McCulloch has a world-wide reputation as a city and interurban electric railroad man. Under his direction there were developed some of the greatest projects in street railroading looking to economy of operation and satisfactory service to the patrons of the lines.

MR. HUGO REISINGER, the well known importer of carbon and other electrical products, died on September 28 at Langen, Schwalbach, near Weisbaden, Germany, where he was born on January 29, 1856. Accompanied by his wife, who was Miss Edmee Busch, daughter of the late Adolphus Busch, and her mother, Mr. Reisinger went to Europe last spring, according to his usual custom, on a business and pleasure trip. Mr. Reisinger had an international reputation as an art expert and connoisseur. He was the first to make a representative collection of modern American art for exhibit in Germany. In 1904 he was an honorary commissioner to Europe for the St. Louis Exposition, and when he went to Europe in April he was appointed honorary commissioner of the Anglo-American Exposition at London, and was placed in charge of the special work of arranging the American art section. Mr. Reisinger graduated from the Royal Gymnasium, at Weisbaden, Germany, in 1875. He engaged in the general importation of merchandise in the United States in 1890, and became one of the largest concerns in his line. He was a director of the Linde Air Products Company of New York and Buffalo, and the Owens European Bottle Machine Company, Toledo, O. He was elected an honorary fellow for life of the Metropolitan Museum of Art, vice-president of the Germanic Museum of Harvard, and the Germanistic Society of New York. Columbia conferred the degree of A. M. on him in 1910. He was Commander of the Order of the Prussian Crown, Commander Order of Merit, with the Star of St. Michael (Bavarian), privy councillor to Prince Regent Ludwig, of Bavaria, and was a member of the following clubs: Lotos, National Arts, German, Railroad, Garden, City Golf, Englewood Country, Automobile Club of America, and the Imperial Automobile Club of Berlin.

DATES AHEAD.

New York Electrical Exposition and Motor Show of 1914. Grand Central Palace, New York, N. Y., October 7-17. General manager, George F. Parker, 124 West Forty-second Street, New York, N. Y.

American Institute of Electrical Engineers. Philadelphia, Pa., October 12. Secretary, F. L. Hutchinson, 29 West Thirty-ninth Street, New York, N. Y.

American Electric Railway Association. Annual convention, Atlantic City, N. J., October 12-16. Secretary, Miss E. B. Burritt, 29 East Thirty-ninth Street, New York, N. Y.

Jovian Order, Annual congress, St. Louis, Mo., October 14-16. Mercury, Ell C. Bennett, Syndicate Trust Building, St. Louis, Mo.

Electric Vehicle Association of America. Fifth annual convention, Philadelphia, Pa., October 19-21. Secretary, A. J. Marshall, 29 West Thirty-ninth Street, New York, N. Y

Kansas Gas, Water, Electric Light and Street Railway Association. Annual convention, Arkansas City, Kans., October 22-24. Secretary, W. H. Fellows, Leavenworth, Kans.

Association of Railway Electrical Engineers. Annual convention, Chicago, Ill., October 26-30. Secretary, J. A. Andreucetti, Room 411, Chicago & Northwestern Terminal Station, Chicago, Ill.

With the Electrical Manufacturers

Railway & Industrial Engineering Company, Pittsburgh, Pa., is mailing a little folder giving in a brief manner the advantages of using higher voltages for electric traction. Considerable data is included for the purpose of comparison.

Wheeler Reflector Company, 156 Pearl Street, Boston, Mass., has recently issued bulletin F. This bulletin is devoted to descriptions, illustrations and prices of globes and reflectors suited for use with gas-filled lamps of ratings up to 1,000 watts.

Transmission Engineering Company, Pittsburgh, Pa., is mailing copies of a folder entitled the Progressive Manager. The illustrations and the text call attention to the company's specialization on designing and fabricating steel work for electrical requirements.

The Sterling Bronze Company, New York City, has been awarded the contract for the electric lighting fixtures for St. Joseph's Cathedral, Columbus, O., which is undergoing extensive remodeling. The fixtures are to be of a very elaborate and costly nature.

The Ohio Brass Company, Mansfield, Ohio, has issued the second number of the *O. B. Bulletin.* This number contains an article by T. S. Dayton entitled "Traction Company's Advertising Fight for Fair Play"; one by J. C. Burns, entitled "Safety-First Talk," and a number of other articles of practical value.

Titan Storage Battery Company, Newark, N. J., has recently issued a well arranged and handsomely illustrated bulletin on Titan storage batteries. The theory of storage batteries is explained in detail, and the parts of Titan batteries are fully described. A number of types of batteries are included, among which are automobile starting, lighting and ignition batteries.

The Crescent Motor Car Company, of Cincinnati, O., manufacturer of the "Ohio" car, announce the adoption of Westinghouse Electric starting, lighting and ignition systems for their cars. This equipment will consist of a starting motor with gear reduction, Bendix screw shift and housings, a combination ignition and lighting generator, switches, voltmeters, fuses and fuse boxes.

The Hartford Time Switch Company, Hartford, Conn., through its general sales agent, A. Hall Berry, 99 Warren Street, New York City, is sending out to those interested in the sale of time switches, some pertinent comments on how many merchants are throwing away much of their rent money by failure to light up store windows. The ease with which the window lighting can be controlled by the Hartford automatic time switch is pointed out.

Westinghouse Lamp Company, New York, N. Y., has recently issued a booklet setting forth a number of new ideas in window displays. These displays are intended for the company's various agencies and for central stations selling the company's lamps. French, English, German, American and international styles of dressing show windows are explained as well as their applications. A number of newspaper advertisements are also illustrated in this booklet.

The A. E. Rittenhouse Company, Honeoye Falls, N. Y., has issued a catalog of its miniature electric aeroplanes. These are now made in three sizes and operated either from five dry cells or from a toy transformer. The first of these aeroplanes put out by the company a year ago proved to be one of the most popular electric toys. Two of the aeroplanes now made are of the Bleriot monoplane type and the third is a miniature Curtis biplane. The company also supplies toy transformers with seven low-voltage secondary taps suitable for operating these aeroplanes, as well as miniature railways, toy motors, etc.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has recently issued several new publications. "Electric Drive of Rubber Calenders" deals with the advantages to be gained by the use of electric drive for this class of work and shows a number of illustrations of actual installations. "Glue Pots and Glue Cookers" shows the methods of installing electrically heated glue pots and glue cookers, and the advantages to be gained from the use of same. Westinghouse electric drive for flour mills is described in Folder 4287, in which some curves are given showing the load on a flour mill driven by electric motors. A complete equipment of these mills is given, together with the advantages secured by this method of drive. Motor-generator sets, utilizing a direct-current generator and an alternating-current motor, are thoroughly described and illustrated in descriptive leaflet No. 3742. The advantages of this type of machine and its characteristics are described.

Record of Electrical Patents.

Issued by the United States Patent Office, September 22, 1914.

1,111,024. Two-Party Telephone System. H. F. Joeckel, Camp Point, Ill. A local battery magneto system.

1,111,033. Contact Wheel for Signal Circuits. W. O. Powers, Jr., Ossining, N. Y., assignor of one-half to Postal Telegraph-Cable Co. A web removable in sections covers contact teeth.

1,111,038. Magnetic Vibrator. F. V. Smith, Floriston, Cal. Armature adjustable with respect to field magnets.

1,111,049. Method of Reducing Ores. R. S. Wile, Pittsburgh, Pa. Electric current passes vertically through bath.

1,111,129. Trolley Pole. W. Blocker, Jackson, Miss. Trolley raised and lowered by compressed air.

1,111,150. Controller for Self-Starters for Engines. R. H. Hassler, assignor to Nordyce & Marmon Co., Indianapolis, Ind. Dynamo for self-starter is connected to battery through a speed-controlled switch.

1,111,161. Tide Motor. G. F. Lemmon, Canton, O. A tide-operated generator and storage battery combination.

1,111,165. Apparatus for Electrically Forming Toes and Heels of Horseshoes. W. B. Miller, assignor to Copper-Die Horseshoe Co., Pittsburgh, Pa. Blank shoes electrically heated while forming heels and toes.

1,111,178. Electrical Controlling Apparatus. O. H. Pieper and A. F. Pieper, Rochester, N. Y. A lever-operated switch.

1,111,182. Temperature-Indicator for Incubators. M. L. Rouse, Columbia, Mo. A thermostat-operated alarm for incubators.

1,111,186. Galvanic Battery. C. B. Schoenmehl, Waterbury, Conn. Covers method of supporting electrodes.

1,111,201. Process of Extracting Zinc from Its Ores or Compounds. E. E. Watts, Kingston, Ontario, Can. Pasty zinc compound is subjected to electrolytic action.

1,111,213. Electric Signal System. A. H. Caven, Youngwood, Pa. For electric railways.

1,111,214. Trolley Switch. A. H. Caven, Youngwood, Pa., For insertion in trolley wire.

1,111,215. Electromagnetic Switch. A. H. Caven, Youngwood, Pa., A signal-operating device.

1,111,236. Thermostat. H. E. Reeve, New York, N. Y. Has special ventilating means.

1,111,240. Overload Motor-Controlling Apparatus. A. Sundh, assignor to Otis Elevator Co., Jersey City, N. J. An automatic motor starter.

1,111,257. Railway Signaling Mechanism. H. A. Hoeschen, assignor to Hoeschen Mfg. Co., Omaha, Neb. An oscillating dynamo.

1,111,253. Loud-Speaking Transmitter. H. C. Egerton, assignor to Western Electric Co., New York, N. Y. Electrodes connected to diaphragm by lever.

1,111,263. Constant-Potential Electrical System. D .R. Lovejoy, Irvington, N. Y. Controlling means for floating-battery system.

1,111,271. Junction Block. A. Plesh, Windber, Pa. A plug.

1,111,289. Electrical Condenser. J. W. Aylsworth, assignor to Halogen Products Co., Glen Ridge, N. J. Dielectric is of carbocylic hydrocarbon and phenolic resin.

1,111,296. Electrical Block-Signaling Mechanism. W. J. Cook and M. W. Breuer, assignors to The Cook Railway Signal Co., Denver, Colo. Mechanism for controlling semaphore arm.

1,111,301. Process of Carrying Out Chemical Reactions in Gases by Means of Electric Arcs. E. Edwin, M. Hähnle and B. Strasser, assignors to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. Process of producing nitrogen oxides.

1,111,344. Electric Train-Control System. E. Woltmann, assignor to Automatic Train Stop Co. Means for supplying energy to rails in sections as needed.

1,111,345. Signal Apparatus. F. W. Wood, assignor to C. Cory & Son, Inc., New York, N. Y. Speed and direction of running vehicle indicated by dials operated by generator.

1,111,351. Submarine Signal-Receiving Instrument. C. Berger, assignor to Submarine Wireless Co., New York City. Includes microphone in water and receiver on boat.

1,111,358. Short-Circuiting Device. E. Bretch, St. Louis, Mo. Centrifugally operated device for induction motor.

1,111,362. Door-Releasing System. J. Carrigan, Seattle, Wash. Melting of fuse causes electromagnets to release door.

1,111,365. System of Distribution. E. E. F. Creighton, assignor to General Electric Co. Circuit-breaker, inductance and capacity in parallel.

1,111,380. Plug Puller. F. C. Hanke, assignor to General Electric Co. For removing fuse plugs. (See cut.)

1,111,381. Arc-Light Electrode. W. L. Harraden, assignor to General Electric Co. A disk electrode with means for conveying current near edges.

1,111,383. Electric Clock. F. Holden, assignor to General Electric Co. A motor-operated pendulum clock.

1,111,394. Electric Train-Control System. H. N. Latey, assignor to Automatic Train Stop Co. Includes means for de-energizing sections to prevent trains from approaching too near each other.

1,111,406. Plug Receptacle and Plug Therefor. H. R. Sargent, assignor to General Electric Co. Receptacle provided with inwardly swinging doors. (See cut.)

1,111,430. Insulating Composition and the Method of Making the Same. L. E. Barringer, assignor to General Electric Co. Made of sulphurized oil, saponified oil and copal.

1,111,442. Apparatus for Applying a Conductive Coating to the Surface of a Mold Used in the Art of Electrotyping. G. E. Dunton, New York, N. Y. Means for holding electrotype mold in inverted position and covering with conducting coating.

1,111,444 and 1,111,445. Method for Treating Molds Used in the Art of Electrotyping. G. E. Dunton, New York, N. Y. Means for removing grease before applying a conducting coating.

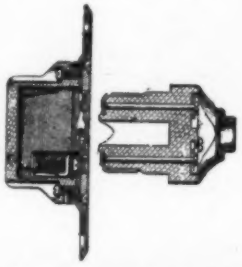
1,111,451. Storage-Battery Cell. B. Ford, Philadelphia, Pa. Has tell-tale for use in filling cells.

1,111,453. Lightning Arrester. G. Giles, Fribourg, Switzerland. Has removable spark gaps.

1,111,468. Automatic Section Insulator. W. H. Kempton, assignor to The Ohio Brass Co., Mansfield, O. An automatically operated trolley switch, the switch element forming part of trolley wire.

1,111,380.—Plug Puller.

1,111,504. Commutating Dynamo-Electric Machine. C. H. Smoot, assignor to Rateau Battu Smoot Co., New York, N. Y. Commutating poles so shaped as to serve as magnetic shields.



1,111,406.—Plug Receptacle and Plug.

1,111,546. Pocket Electric Light. P. H. Oelman, assignor to Traders Metal Goods Co., Inc., New York, N. Y. Contact-making device acts as clip for securing lamp in pocket.

1,111,555. Trolley Switch. J. C. Atterbury, Danville, Ill., assignor of one-half to C. G. Taylor. Is solenoid operated.

1,111,652.—Electrically Operated Alarm.

1,111,566. Telegraph Repeater. R. T. Davenport, Williams, Ariz. Covers details.

1,111,570. Insulator. E. Friedlaender, Braddock, Pa. A third-rail insulator.

1,111,574. Line Protector for Telegraph and Telephone Systems. T. Gonzales y Sebasco, Habana, Cuba. Built in two sections.

1,111,615. Automobile Signal. J. A. Ross, New York, N. Y., assignor of one-third to F. Pons. Electromagnets rotate a signal dial.

1,111,623. Electric-Light Pendant. W. O. Teasdale, Manila, P. I. A telescopic ceiling fixture.

1,111,652. Electrically Operated Alarm. H. W. Fryling, Lowell, N. C. A contact device for giving alarm when hot bearings occur. (See cut.)

1,111,695. Type-Printing Telegraph Apparatus for Line and Radio Telegraphy. A. N. Hovland, assignor to A. S. Hovlands Radiotelegraf, Christiania, Norway. An electromagnetically operated printing attachment.

1,111,708. Automatic Fire-Alarm System. I. B. Simms, Sacramento, Cal., assignor of one-third to F. Hunt. Operated by thermostats.

Re-issue 13,802. Automatic Electric Exchange System. W. R. Binkley, assignor to Western Electric Co. An automatic exchange.

Patents Expired.

The following United States electrical patents expired September 28, 1914:

590,589. Electric trolley device. A. B. DuPont, Detroit, Mich.

590,599. Signaling for electric railways. J. B. Struble, Wilkinsburg, Pa.

590,600. Signaling. J. B. Struble, Wilkinsburg, Pa.

590,603. Electric fire-alarm system. J. L. Walker and G. B. Walker, Pensacola, Pa.

590,633. Telephone system and telephone exchange mechanism. P. Snow, Erie, Pa.

590,653. Shielding device for electric meters. E. Thomson, Swampscott, Mass.

590,654. Electric measuring instrument. E. Thomson, Swampscott, Mass.

590,667. Elevator attachment. H. Mattullath, New York, N. Y.

590,670. Electric Arc Lamp. A. Poulsen, Buffalo, N. Y.

590,673. Process of and Apparatus for Electrically Treating Ores. F. H. Soden, Chicago, Ill.

590,725. Electric Arc Lamp. H. Leitner, London, England.

590,750. Safety Fuse for Electrical Devices. D. J. Cartwright, Boston, Mass.

590,808 and 590,809. Magnetic Ore-Separator. L. G. Rowand Camden, N. J.

590,817. Elevating-Gear Attachment. W. H. Bevans, Washington, D. C.

590,826. Porous Diaphragm for Electrolytic Apparatus. J. D. Darling, Philadelphia, Pa.

590,838. Incandescent-Electric-Lamp Fixture. B. B. Hoffman, New York, N. Y.

590,852. Electrical Transformer. W. D. Packard and J. W. Packard, Warren, O.

590,877. Danger Signal for Railway Crossings. O. P. Bonner, Crawfordsville, Ga.

590,881 and 590,882. Electric Railway. J. W. Darley, Jr., Baltimore, Md.

590,916. Electric Heater. R. A. L. Snyder, Pittsburgh, Pa.

590,920. Secondary Battery. M. DeContades, Paris, France.